31R2-3BC640-22

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CLASSIFICATION CANCELLED
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DATE 26 SEPT 47

AN 16-40BC640-2
(Old No. AN 08-40BC640-2)

HANDBOOK
MAINTENANCE INSTRUCTIONS

RADIO TRANSMITTERS
BC-640-A AND BC-640-B

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COURIER-JOURNAL LITHO. CO., LOUISVILLE, KY.
3500-10-20-53

19 NOVEMBER 1943
REVISED 25 MARCH 1952

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Page No.	*Date of Latest Revision*
iii	26 September 1947
iv	26 September 1947
9	26 September 1947
15	22 July 1949
32	26 September 1947
33	26 September 1947
34	26 September 1947
35	26 September 1947
37	26 September 1947
41	26 September 1947
42	26 September 1947
44	26 September 1947
45	26 September 1947
46	26 September 1947
50	26 September 1947
59	26 September 1947
60	26 September 1947
61	26 September 1947
62	26 September 1947
66	26 September 1947
68	26 September 1947
69	26 September 1947
72	26 September 1947
73	26 September 1947
74	26 September 1947
75	26 September 1947
76	27 July 1944
77	26 September 1947
78	26 September 1947
79	26 September 1947
80	27 July 1944
81	26 September 1947
82	26 September 1947
83	26 December 1951
84	26 September 1947
85	26 September 1947
86	26 September 1947
87	26 September 1947
88	26 September 1947
89	26 September 1947
90	26 September 1947
91	26 September 1947
92	27 July 1944
101	26 September 1947
104	26 September 1947
106	26 September 1947
110	26 September 1947
115	26 September 1947
129-130	26 September 1947
*130A	25 March 1952
131-132	4 February 1952
*132A	25 March 1952

* The asterisk indicates pages revised, added or deleted by the current revision.

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DESTRUCTION OF ABANDONED MATERIEL IN THE COMBAT ZONE

In case it should become necessary to prevent the capture of this equipment and when ordered to do so, DESTROY IT SO THAT NO PART OF IT CAN BE SALVAGED, RECOGNIZED OR USED BY THE ENEMY. BURN ALL PAPERS AND BOOKS.

Means:—

1. Explosives, when provided.
2. Hammers, axes, sledges, machetes, or whatever heavy object is readily available.
3. Burning by means of incendiaries such as gasoline, oil, paper, or wood.
4. Grenades and shots from available arms.
5. Burying all debris or disposing of it in streams or other bodies of water, where possible and when time permits.

Procedure:—

1. Obliterate all identifying marks. Destroy nameplates and circuit labels.
2. Demolish all panels, castings, switch- and instrument-boards.
3. Destroy all controls, switches, relays, connections, and meters.
4. Rip out all wiring and cut interconnections of electrical equipment. Smash gas, oil and water-cooling systems in gas-engine generators, etc.
5. Smash every electrical or mechanical part, whether rotating, moving, or fixed.
6. Break up all operating instruments such as keys, phones, microphones, etc.
7. Destroy all classes of carrying cases, straps, containers, etc.
8. Bury or scatter all debris.

DESTROY EVERYTHING!

UNSATISFACTORY REPORT

For U. S. Army Air Force Personnel:—

In the event of malfunctioning, unsatisfactory design, or unsatisfactory installation of any of the component units of this equipment, or if the material contained in this book is considered inadequate or erroneous, an Unsatisfactory Report, AAF Form No. 54, or a report in similar form, shall be submitted in accordance with the provisions of Army Air Force Regulation No. 15-54 listing:

1. Station and organization.
2. Nameplate data (type number or complete nomenclature if nameplate is not attached to the equipment).
3. Date and nature of failure.
4. Airplane model and serial number.
5. Remedy used or proposed to prevent recurrence.
6. Handbook errors or inadequacies, if applicable.

For U. S. Navy Personnel:—

Report of failure of any part of this equipment during its guaranteed life shall be made from N. Aer. 4112, "Report of Unsatisfactory or Defective Material," or a report in similar form, and forwarded in accordance with the latest instructions of the Bureau of Aeronautics. In addition to other distribution required, one copy shall be furnished to the Inspector of Naval Material (1600 Arch Street, Philadelphia, 3, Pa.,) and the Bureau of Ships. Such reports of failure shall include:

1. Reporting activity.
2. Nameplate data.
3. Date placed in service.
4. Part which failed.
5. Nature and cause of failure.
6. Replacement needed (yes—no).
7. Remedy used or proposed to prevent recurrence.

For British Personnel:—

Form 1022 procedure should be used when reporting failure of radio equipment.

SPECIAL NOTICE

The most common fault with field communication equipment is loose or bad connections. Look first for this. The second most common repair needed is due to wrong adjustments by unqualified operating personnel. There are almost no internal adjustments or repairs you should do on this unit. Use a spare unit if you can get one and send for your experienced repairman. His experience and equipment is sure to save the extra time.

A FEW INDISCRIMINATE INTERNAL ADJUSTMENTS ON EQUIPMENT OPERATING AT THESE FREQUENCIES MAY CAUSE A FACTORY REPAIR JOB WHERE A SIMPLER REPAIR JOB WOULD HAVE FIXED IT.

SAFETY NOTICE

THIS EQUIPMENT USES HIGH VOLTAGES WHICH ARE DANGEROUS TO LIFE. YOU MUST AT ALL TIMES OBSERVE ALL SAFETY RULES.

DON'T CHANGE TUBES, INSTALL FUSES, OR MAKE ADJUSTMENTS INSIDE EQUIPMENT WITH LINE VOLTAGE SUPPLY ON.

DON'T DEPEND ON THE DOOR INTERLOCK FOR PROTECTION. ALWAYS OPEN POWER MAINS SWITCH.

DON'T TAMPER WITH THE INTERLOCK. NEVER REMOVE THE SAFETY INTERLOCK SWITCH OR SHORT CIRCUIT IT, OR TAMPER WITH IT IN ANY WAY, NOR SHOULD YOU RELY ON THE INTERLOCK SWITCH FOR REMOVING VOLTAGES FROM THE EQUIPMENT.

THERE MAY BE DANGEROUS POTENTIALS IN CIRCUITS WITH POWER CONTROLS AT OFF AT TIMES DUE TO CHARGES HELD BY CAPACITORS.

ALWAYS GROUND CIRCUITS BEFORE YOU TOUCH THEM.

DON'T ALLOW THE AMPLIFIER CATHODE CURRENT TO EXCEED 75 MA LONGER THAN 5 SECONDS.

DON'T ALLOW THE OUTPUT VOLTAGE METER TO VARY FROM THE RED LINE (230-V) READING WHEN THE TRANSMITTER IS TURNED ON.

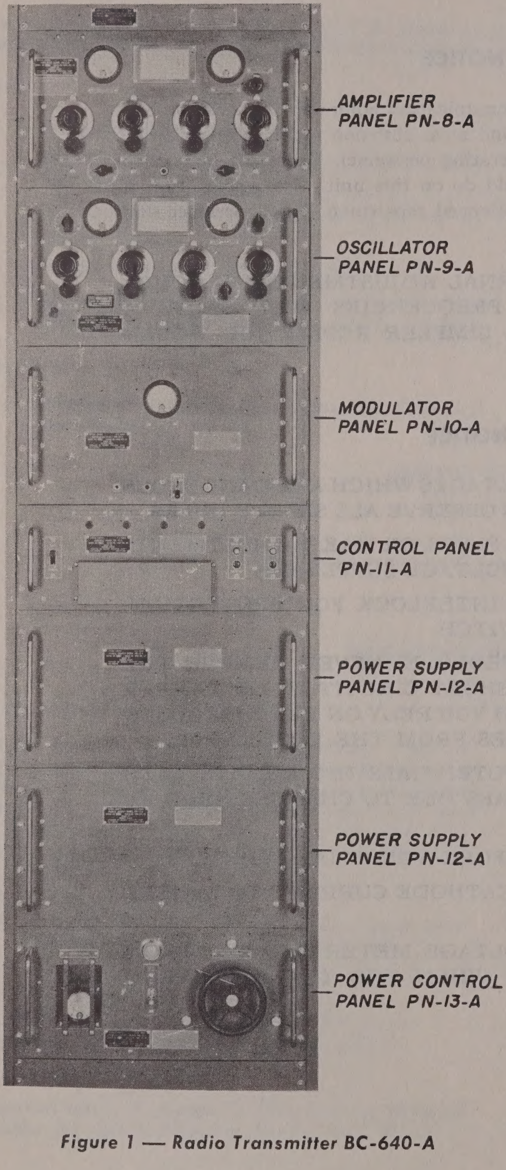

AMPLIFIER PANEL PN-8-A
OSCILLATOR PANEL PN-9-A
MODULATOR PANEL PN-10-A
CONTROL PANEL PN-11-A
POWER SUPPLY PANEL PN-12-A
POWER SUPPLY PANEL PN-12-A
POWER CONTROL PANEL PN-13-A

Figure 1 — Radio Transmitter BC-640-A

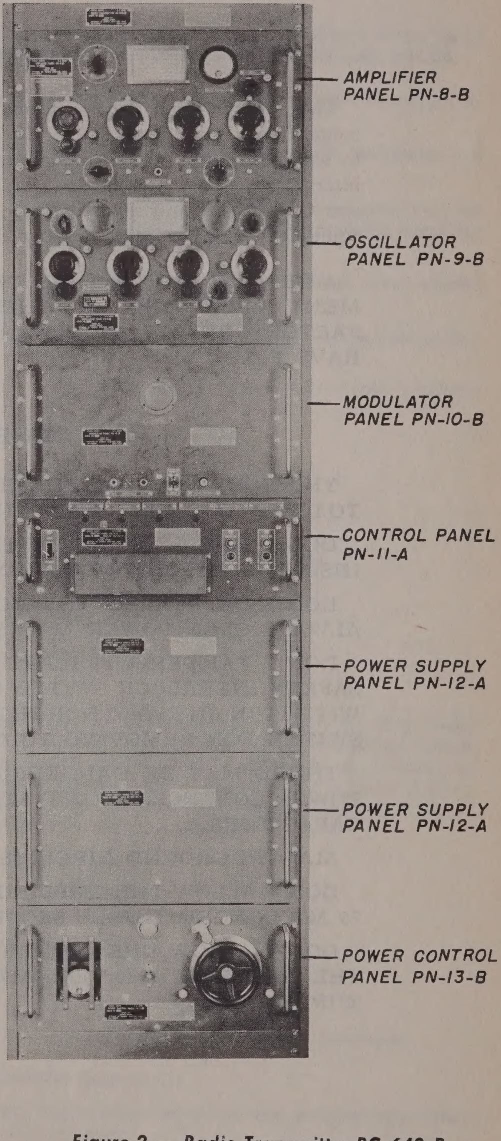

AMPLIFIER PANEL PN-8-B
OSCILLATOR PANEL PN-9-B
MODULATOR PANEL PN-10-B
CONTROL PANEL PN-11-A
POWER SUPPLY PANEL PN-12-A
POWER SUPPLY PANEL PN-12-A
POWER CONTROL PANEL PN-13-B

Figure 2 — Radio Transmitter BC-640-B

SECTION I

GENERAL DESCRIPTION

1. GENERAL.

Radio Transmitter BC-640-A is used in ground stations for communicating with aircraft on frequencies ranging from 100 to 156 mc (3 to 1.92 meters wave-length). *Radio Transmitters BC-640-A and BC-640-B are alike except that in the latter all meters except two have been omitted, their work being done by a meter on Amplifier Panel PN-8-B through a five position switch.* The circuit design of each is essentially the same although there are minor variations such as the inclusion of additional components and the exclusion of others. All BC-640-B panels have dial locks. The changes involved are amply covered in this book, and reference will be made only to Radio Transmitter BC-640-A, unless otherwise stated. All basic functions, theory and parts are the same for both models. The transmitter is rugged, and is easy to adjust and operate. It is compact, taking less than three square feet of floor space. Frequency changing is accomplished by substituting crystals and adjusting controls; no coils need be changed, in spite of the wide frequency band covered. The transmitter has all speech and radio frequency amplifiers needed for sending both voice-modulated and 1000 cps modulated signals. Power output is about fifty watts, ranging from 51.5 watts at 100 mc to 46 watts at 156 mc. The transmitter is enclosed in a heavy steel cabinet screened against insects and mice. The panels are standard 19″ relay rack type. Any panel can be replaced quickly for repair with little interruption to service. The transmitter's ruggedness, power, and arrangement for local or remote control make it adaptable for use in communications systems.

Its frequency band is usually free from atmospheric static interference. Since coverage at these frequencies is almost on a line-of-sight basis, the range depends almost entirely on the altitude of the receiving airplanes and the site selected for the transmitting station. This is because very high frequency waves, like light waves, travel only in straight lines, since they are not reflected by any of the ionized layers of the upper atmosphere. The coverage may be extended by the fact that these wave paths become slightly bent, extending the range over the curved surface of the earth about 15 per cent farther. This permits communication with receiver stations on the ground approximately 26 miles distant, and aircraft approximately 155 miles distant when at an altitude of 10,000 feet. These ranges are considered conservative for reasonably level country. Under certain conditions of terrain or altitude the range will be substantially greater. In very hilly country, the range will probably be reduced, and reflection effects might be expected which would give rise to zones of low signal strength. For practical purposes, it may be considered that the signals from Radio Transmitter BC-640-A will follow optical paths and the reliable range of the transmitter will be limited to the line-of-sight from the transmitter antenna to the receiver antenna.

2. COMPONENTS.

a. RADIO TRANSMITTER BC-640-A and BC-640-B.

BC-640-A	*BC-640-B*	*Description*	*Overall Size in Inches (Including Projections)*	*Weight (Lbs.)*
1		Radio Transmitter BC-640-A	72⅜ x 21¼ x 20	601.5
	1	Radio Transmitter BC-640-B		
1		Amplifier Panel PN-8-A complete with tubes	10½ x 19 x 16¼	41.5
	1	Amplifier Panel PN-8-B complete with tubes		

BC-640-A	*BC-640-B*	*Description*	*Overall Size in Inches (Including Projections)*	*Weight (Lbs.)*
1		Oscillator Panel PN-9-A complete with tubes and crystal	10½ x 19 x 16¼	39.0
	1	Oscillator Panel PN-9-B complete with tubes and crystal		
1		Modulator Panel PN-10-A complete with tubes	10½ x 19 x 15	48.0
	1	Modulator Panel PN-10-B complete with tubes		
1	1	Control Panel PN-11-A	6 31/32 x 19 x 8⅝	27.0
2	2	Power Supply Panels PN-12-A complete with tubes	10½ x 19 x 14½	84.0 (each)
1		Power Control Panel PN-13-A (less transformer)	8¾ x 19 x 9	40.0
	1	Power Control Panel PN-13-B (less transformer)		
1	1	Power Input Transformer and Support		27.5
1	1	Cabinet CS-88-A	72⅜ x 21¼ x 18¼	210.5

b. **TUBE COMPLEMENT.—Radio Transmitter BC-640-A and Radio Transmitter BC-640-B each use 23 tubes. Their types and functions are as follows:**

Quantity	*Mfr. Type*	*Function*	*Signal Corps Type*
8	5Z3	High-vacuum rectifier	VT-145
5	3C24/HK-24-G	Radio freq. triode	VT-204
4	6J5	High-mu metal type triode	VT-94
*3	1613 or 6F6	R-F and A-F metal type pentode	VT-175 or VT-66
1	807	R-F beam power tube	VT-100
2	811	Zero-bias class B amplifier	VT-217

*Some radio transmitters use VT-66 (6F6) tubes in place of VT-175 in A.F. circuits.

3. TYPES OF OPERATION.

Radio Transmitter BC-640-A is used in either portable or fixed installations. It can be modulated locally by a microphone plugged into the front panel, or remotely by connecting wire lines to the cabinet terminal board. The circuit of Modulator Panel PN-10-A is so arranged that plate supply is removed from the final r-f amplifier during standby periods from the remote operating position, cutting the carrier off the air. Although voice modulation is normally used, it has a 1000 cps audio oscillator for MCW transmission if needed. This requires only connection of two wires to chassis terminals (see paragraph 19*c*). These two wires must be connected to the terminals of a telegraph key (*not supplied with the equipment*). The transmitter will key satisfactorily at speeds up to 30 words per minute. Maximum line resistance permissible for voice modulation is 500 ohms.

4. POWER REQUIREMENTS.

The primary power requirements are:

110-125v, 50/60-cycle, single-phase a-c, or 220-250v, 50/60-cycle, single-phase a-c.

Total power required from the line at either voltage is:

Unmodulated	*Modulated 100%*
.891 KVA	.918 KVA
815 Watts	860 Watts
91.5% PF	93.8% PF

5. ANTENNA REQUIREMENTS.

Radio Transmitter BC-640-A is normally used with a half-wave vertical antenna, current-fed by a balanced, untuned, concentric (coaxial) transmission line having a characteristic impedance of 72 ohms. The output terminal on Amplifier Panel PN-8-A is so made that plugging in the antenna cable gives firm contact, and the cable terminal is provided with screws to secure Plug PL-307 coaxial cable in place (paragraph 14*c* and figure 7).

6. ADDITIONAL EQUIPMENT REQUIRED.

Besides the antenna and source of power, the only additional equipment required for operation of the transmitter is:

1—Single-button carbon microphone with plug, for local operation

1—Headset, for monitoring carrier

1—Telegraph key, for MCW operation

1—Crystal Unit DC-11-A or

1—Crystal Unit DC-16 and Crystal Adapter M-366-A

NOTE

Later models are equipped with a combination socket which fits either crystal unit without an adapter.

7. CABINET CS-88-A.

The cabinet acts as a frame for holding all the panels of the radio transmitter, as well as protecting and shielding the equipment. A single door in the rear permits access to all panels. Openings, screened on the inside to exclude insects and mice, are provided in the sides, top, and rear of the transmitter. The cabinet is equipped with a door interlock switch which disconnects the high voltage supply to the transmitter when the door is opened. In addition to six Allen wrenches in a rack, five compartments are on the rear door for the following:

a. Master tuning charts for Amplifier Panel PN-8-A.

b. Master tuning charts for Oscillator Panel PN-9-A.

c. Blank front panel tuning charts for Amplifier Panel PN-8-A.

d. Blank front panel tuning charts for Oscillator Panel PN-9-A.

e. Overall schematic diagram with parts list.

The transmitter components are rack mounted on front of the cabinet. All panels of the transmitter can be removed from the front for repair, replacement, or service, by disconnecting all leads at the rear and removing the mounting screws in front. The rear door hinges have loose pins, so that the rear door can be completely removed where there is not enough clearance to open it otherwise. This in no way affects the operation of the door interlock switch.

8. POWER CONTROL PANEL PN-13-A.

This panel controls the line input voltage to the radio transmitter. It includes: the line fuses, the main power switch, a voltmeter to measure the voltage supplied to the rest of the transmitter, an indicator lamp to show whether the transmitter is turned on, and a variable-ratio autotransformer (variac) to compensate for various input voltages. By means of this transformer, the voltage supplied to the rest of the transmitter is maintained at 230 volts. Behind this panel is the cabinet terminal board. This has terminals for connecting 110-125v or 220-250v input, as well as a remote microphone line, a remote monitoring line, and a remote signal lamp line to indicate at the remote operating position whether the transmitter is available for remote speech input. There is also an autotransformer mounted to the cabinet, CS-88-A, behind the panel. This is used to step up the supply voltage from 110 to 220 volts when 110-volts power is supplied to the transmitter.

9. POWER SUPPLY PANEL PN-12-A.

Two identical power supply panels are provided on the transmitter, one above the other. The lower one provides all plate potentials for Amplifier Panel PN-8-A and Oscillator Panel PN-9-A. The upper one provides all plate potentials for the tubes in Modulator Panel PN-10-A. All filament power comes from individual windings on filament transformers mounted on the amplifier, oscillator and modulator panels. Each power supply panel uses four rectifier tubes, Tube VT-145 and delivers terminal potentials of 315, 395, and 800 volts d-c. There are no controls on the front panel of either power supply unit.

10. CONTROL PANEL PN-11-A.

The control panel contains ON-OFF switches for plate and filament supplies to all the components of the transmitter, as well as indicator lamps for the r-f and a-f filament and plate circuits. The individual switches for these circuits are normally covered by a stout sheet-metal cover, which is to be taken off only when trouble-shooting. Two master switches, at the right of the panel, control filament and plate power to the entire transmitter. A toggle switch at the left of the panel, labeled TUNE-OPERATE, reduces plate voltage to all tubes in the oscillator and amplifier panels in the TUNE position and applies the full potentials in the OPERATE position. It is used to prevent overloading the tubes while tuning the transmitter. All fuses in the transmitter, except the line fuses, are on the back of the control panel.

24-volt d-c power supply, using a metallic rectifier, is included in this unit for low-voltage d-c operation of relays in the transmitter, remote signal lamps, remote microphone line and the local microphone when used.

11. MODULATOR PANEL PN-10-A.

The modulator unit provides high-level plate modulation for the final power amplifier. It uses two tubes, Tube VT-94 in the input as a push-pull voltage amplifier stage. Two tubes, Tube VT-175 or VT-66 follow as a push-pull driver stage, driving two tubes, Tube VT-217 as a class B modulator. One tube, Tube VT-94 is used as a 1000-cps audio oscillator for modulation testing and for modulating the carrier when MCW operation is desired. The modulator is powerful enough to provide 100% modulation with either voice or 1000-cps input. A LOCAL-REMOTE switch on the front panel connects the input to either the remote line or the two MICROPHONE jacks on the front panel. A volume control, slotted for screwdriver adjustment, is on the front panel. It controls the gain of the speech amplifier. Leads for keying the transmitter in MCW operation are brought out to terminals at the rear of this panel (paragraph 14*d*).

12. OSCILLATOR PANEL PN-9-A.

The oscillator panel provides the r-f energy to drive the final amplifier at the output frequency. The signal frequencies generated by this unit are obtained through frequency multiplication from crystals whose frequencies lie within the range from 5555.5 kc to 8666.6 kc. A metal tube, Tube VT-175 or VT-66 is used as the oscillator operating on the fundamental frequency of the crystal. The oscillator feeds a tripler tube, Tube VT-100 which in turn drives a second tripler tube, Tube VT-204. This second tripler drives a tube, Tube VT-204 operated as a doubler, and the doubler drives a tube, Tube VT-204 used as a straight intermediate power amplifier.

The power output to the final Amplifier Panel PN-8-A is about 15 watts. Since 3 x 3 x 2 = 18, the final output frequency is 18 times the crystal fundamental.

A double plug, with its terminals short-circuited, functions as a neutralizing link. When taken out, it removes plate supply from the intermediate power amplifier.

13. AMPLIFIER PANEL PN-8-A.

This is the final amplifier stage of the transmitter. It supplies about 50 watts of power to a concentric cable with a characteristic impedance of 72 ohms. Two tubes, Tube VT-204 are operated in push-pull as straight class C amplifiers. One tube, Tube VT-94 rectifies a very small portion of the antenna current. The output of this tube is available at the MONITOR TEL. jack on the front panel as well as at the cabinet terminal board for local or remote monitoring. Like the oscillator panel, the amplifier is equipped with a plug at the rear of the chassis to remove plate voltage from the amplifier tubes when neutralizing.

SECTION II
INSTALLATION AND ADJUSTMENT

14. INSTALLATION.

a. MOUNTING AND FASTENING.—Radio Transmitter BC-640-A occupies a minimum of floor space. It is six feet high. It is important that the cabinet be securely fastened to the floor in fixed installations, and to both floor and ceiling in portable installations, or a violent shock might upset it. When the transmitter is installed in *trucks and trailers,* always use rubber shockmounts at top and bottom. Cabinet CS-88-A is drilled at top and bottom for this purpose (see figure 4 for mounting hole layout). In fixed stations, the transmitter is usually mounted on wooden blocks, the blocks being in turn fastened to the floor, as are the shockmounts when used. The procedure for mounting the transmitter will depend entirely on the type of fastening to be used. The holes in the bottom of the cabinet can be reached by opening the rear door. When using shockmounts, it is possible to insert the bolt, apply shockmount, lock washer and nut and tighten from the outside. If lag bolts are used, there may not be enough room to use a wrench. If so, disconnect wiring at the rear of Power Control Panel PN-13-A, remove front panel screws, and lift panel from the transmitter. The cabinet terminal board and the autotransformer can then be unscrewed and swung out of the way, exposing the bottom mounting holes. *Be sure to allow from six to twelve inches clearance at the sides of the transmitter for circulation of air.* Allow enough clearance at the rear to open the door, which swings on a radius of 17 inches. If there is not enough room to swing it open, the rear door can be removed by pulling the pins out of the hinges.

b. POWER CONNECTIONS.—Two #14 wires are used to supply power to the transmitter. DO NOT USE WIRE SMALLER THAN #14. To connect these wires, remove the bottom panel at the rear of the transmitter, below the door. Looking at the rear of the transmitter, a hole will be found in the left side wall three inches from the rear and seven and one-half inches from the bottom. Run the two #14 wires through this hole and connect them to the cabinet terminal board, as shown in figure 6. If a 110-volt power source is to be used, connect the wires to the terminals marked 110/125v. If a 220-volt power source is to be used, connect them to the terminals marked 220/250v. If flexible conduit (BX cable) is obtainable, it should be used and secured to the cabinet wall by a proper connector. Neither side of the line is grounded within the transmitter proper. If the plate contactor relay on Control Panel PN-11-A hums excessively or chatters when the transmitter is in operation, the power input connections should be reversed. Ground wires from the various panels are connected to a stud on the side of Cabinet CS-88-A, just below the hole for the power wires. Connect this stud to a dependable ground, using wire not smaller than #14.

c. ANTENNA CONNECTION.—The coaxial cable from the antenna enters the transmitter from the rear, above the door, and fastens to a socket projecting from the rear of Amplifier Panel PN-8-A, or PN-8-B. A rubber grommet is used to prevent chafing of the cable insulation where it enters the cabinet. To permit entrance of the large coaxial cable terminal, there are two small removable plates above the rear door. To connect the coaxial cable to the transmitter, remove the screws holding these plates to the cabinet (see figure 7). Remove the plates. Loosen the four special #10-32 screws holding the protective cap on the end of the coaxial cable terminal and remove the protective cap. DO NOT TAKE THESE SCREWS ALL THE WAY OUT. It is not necessary, and they might get lost. Insert the end of the coaxial cable through the opening in the back of the cabinet, and plug the cable terminal to the antenna socket on the rear of the amplifier panel. Secure the coaxial cable terminal to the antenna socket by screwing in the four special screws which held the protective cap in place. Put the split rubber grommet in place around the antenna cable. Replace the plates above and below the grommet and screw them to the transmitter cabinet. Fasten the coaxial cable out of the way of pedestrian or other traffic.

d. COMMUNICATIONS WIRING.—With the exception of the MCW keying terminals, all connections for remote control are made to the cabinet terminal board (see figure 6). Terminals 34 and 35 are supplied with 24 volts d-c when the LOCAL-REMOTE key on the modulation panel is at

REMOTE. This voltage is intended for lighting a lamp at the remote control position, showing that the transmitter is turned on and can be modulated from that point (see paragraph 28). Terminals 36 and 37 are the remote microphone terminals. When the LOCAL-REMOTE key on the modulation panel is at REMOTE, they are supplied with 24 volts d-c to supply the microphone at the remote operating position. Terminals 38 and 39 are for monitoring. They are connected at all times to the output of the monitor rectifier on Amplifier Panel PN-8-A, and can be connected by wires to the remote operating position or station control equipment. Thus it is possible to monitor all transmissions from the remote operating point, even when the transmitter is locally modulated by a microphone plugged into the modulation panel. If MCW operation is desired, connect the key terminals to terminals 11 and 12 on Modulator Panel PN-10-A.

15. PREPARATION FOR USE.

Before turning on Radio Transmitter BC-640-A, make the following checks:

a. Make sure the main station switch supplying line voltage to the radio transmitter cabinet is at OFF.

b. Make sure the radio transmitter POWER MAINS switch at the bottom of the transmitter on Power Control Panel PN-13-A is also at OFF.

c. At the main station switch, check the line voltage to be used on the transmitter and insert the proper fuses in the following manner:

(1) Open the cabinet door at the rear of the transmitter.

(2) If the line voltage is 110/125 volts, insert 10-ampere fuses into the fuse clips marked 10a located behind Power Control Panel PN-13-A.

(3) If the line voltage is 220/250 volts, insert 5-ampere fuses into the fuse clips marked 5a located behind Power Control Panel PN-13-A.

(4) Insert two 5a, two 3a, and two 2a fuses into the proper clips behind Control Panel PN-11-A. The fuse clips are marked with proper amperage.

d. Insert all vacuum tubes into their proper sockets and make certain the retaining clips are in the locked position—*the tube type number is marked near each socket.*

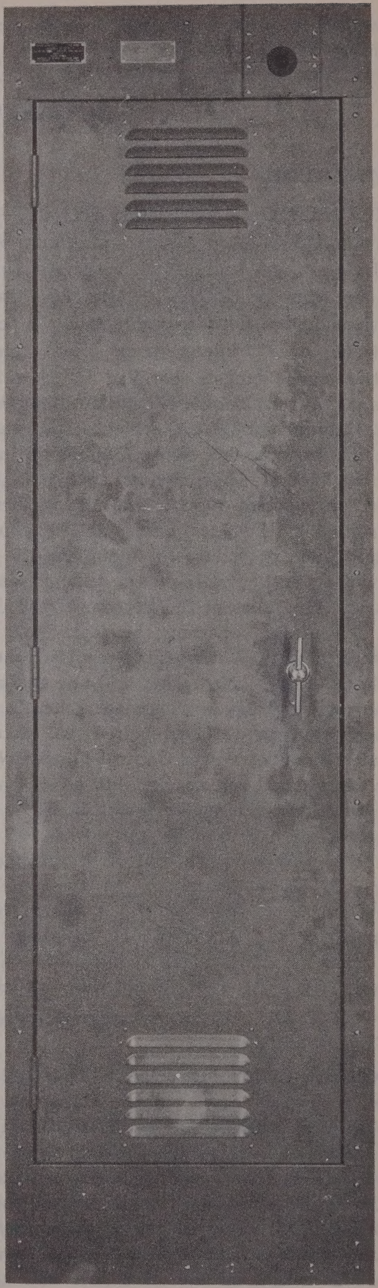


Figure 3 — Radio Transmitter BC-640-A, and BC-640-B, Rear View

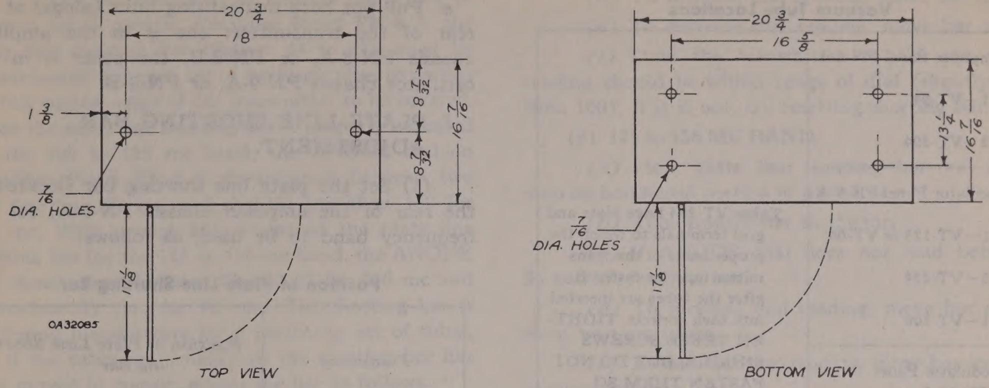

20 3/4
18
1 3/8
8 7/32
8 7/32
16 7/16
7/16 DIA. HOLES
17 1/8
OA32085
TOP VIEW
20 3/4
16 5/8
13 1/4
16 7/16
7/16 DIA. HOLES
17 1/8
BOTTOM VIEW

Figure 4 — Cabinet CS-88-A, Mounting Hole Layout

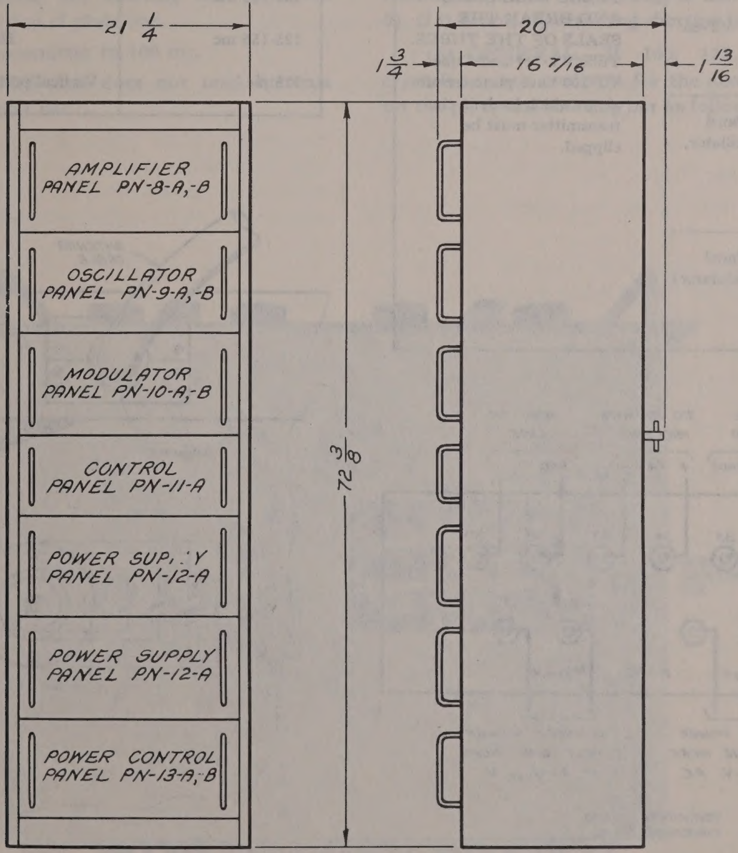

21 1/4
20
1 3/4
16 7/16
1 13/16
72 3/8
AMPLIFIER PANEL PN-8-A,-B
OSCILLATOR PANEL PN-9-A,-B
MODULATOR PANEL PN-10-A,-B
CONTROL PANEL PN-11-A
POWER SUPPLY PANEL PN-12-A
POWER SUPPLY PANEL PN-12-A
POWER CONTROL PANEL PN-13-A,-B

Figure 5 — Radio Transmitter BC-640-A, and BC-640-B, Outline Drawing

Vacuum Tube Locations

Amplifier Panel PN-8-A	Tubes VT-204 have plate and grid terminals to which the proper leads in the transmitter must be fastened after the tubes are inserted into their sockets. TIGHTEN THESE SCREWS SNUGLY, BUT DO NOT FASTEN THEM SO TIGHTLY THAT THE LEADS FROM THE TUBES WILL BEND AND BREAK THE SEALS OF THE TUBES. Tube VT-217 and Tube VT-100 have plate terminals to which leads in the transmitter must be clipped.
1—VT-94	
2—VT-204	
Oscillator Panel PN-9-A	
1—VT-175 or VT-66	
3—VT-204	
1—VT-100	
Modulator Panel PN-10-A	
3—VT-94	
2—VT-175 or VT-66	
2—VT-217	
Power Supply Panel PN-12-A (Oscillator, Amplifier)	
4—VT-145	
Power Supply Panel PN-12-A (Modulator)	
4—VT-145	

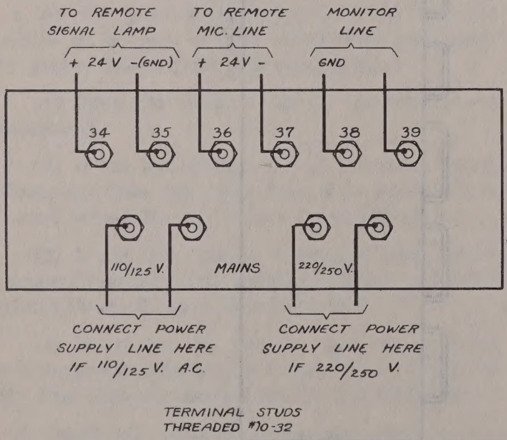

TO REMOTE SIGNAL LAMP
TO REMOTE MIC. LINE
MONITOR LINE
+ 24 V -(GND)
+ 24V -
GND
34
35
36
37
38
39
110/125 V.
MAINS
220/250 V.
CONNECT POWER SUPPLY LINE HERE IF 110/125 V. A.C.
CONNECT POWER SUPPLY LINE HERE IF 220/250 V.
TERMINAL STUDS THREADED #10-32

Figure 6 — Cabinet Terminal Board Showing Connections

e. Pull out both neutralizing links (plugs) at the rear of the transmitter; one is in the amplifier chassis PN-8-A, or PN-8-B, the other is in the oscillator chassis PN-9-A, or PN-9-B.

f. PLATE LINE SHORTING BAR ADJUSTMENT.

(1) Set the plate line shorting bar (located at the rear of the amplifier chassis PN-8-A) for the frequency band to be used, as follows:

Position of Plate Line Shorting Bar

Frequency	*Position of Plate Line Shorting Bar*
100-125 mc	Vertical
125-156 mc	Horizontal
125 mc	Vertical portion just below bend

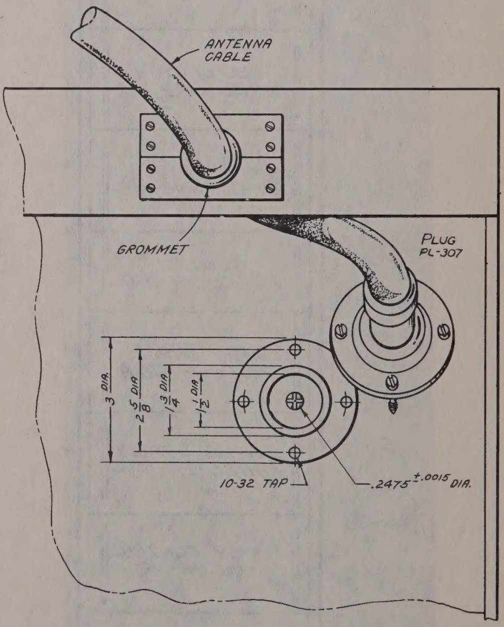

ANTENNA CABLE
GROMMET
PLUG PL-307
3 DIA.
2 5/8 DIA.
1 3/4 DIA.
1 1/2 DIA.
10-32 TAP
.2475 ±.0015 DIA.

Figure 7 — Radio Transmitter BC-640-A, and BC-640-B, Antenna Cable Connections

(2) Due to variations in element capacities of vacuum tubes used in Amplifier Panel PN-8-A, the plate line shorting bar (figures 44 to 47) must be set accurately for each set of vacuum tubes to permit the full tuning range of the transmitter to be covered. When the plate line shorting bar is properly adjusted for the 100 to 125 mc band, the ANODE dial on Amplifier Panel PN-8-A should read between two and five for 100 mc and slightly less than 100 for 125 mc. With proper adjustment of the plate line shorting bar for the 125 to 156 mc band, the ANODE dial should read between 95 and 97 for 156 mc and approximately zero for 125 mc. The shorting bar is set during manufacture for a particular set of tubes, but if the tubes are changed or the shorting bar has been moved in transit, adjust the bar as follows:

(3) 100 to 125 MC BAND.

(a) Place plate line shorting bar ¼″ from stop on vertical portion of plate line.

(b) Tune transmitter to 100 mc.

(c) If ANODE dial does not read between two and five, readjust bar.

(d) To increase dial reading, move bar down.

(e) To decrease dial reading, move bar up.

(f) Tune the transmitter to 125 mc. Dial reading should be within range of dial (slightly less than 100). If it is not, try resetting shorting bar.

(4) 125 to 156 MC BAND.

(a) Place plate line shorting bar ¼″ from stop on horizontal portion of plate line.

(b) Tune transmitter to 156 mc.

(c) If ANODE dial does not read between 95 and 97, readjust bar.

(d) To increase dial reading, move bar away from vacuum tubes.

(e) To decrease dial reading, move bar toward vacuum tubes.

(f) Tune the transmitter to 125 mc. Dial reading should be within range of dial (approximately 0). If it is not, try resetting shorting bar.

(5) GENERAL.—If 100, 125, and 156 mc crystals are not available for the above adjustments, set the plate line shorting bar as follows:

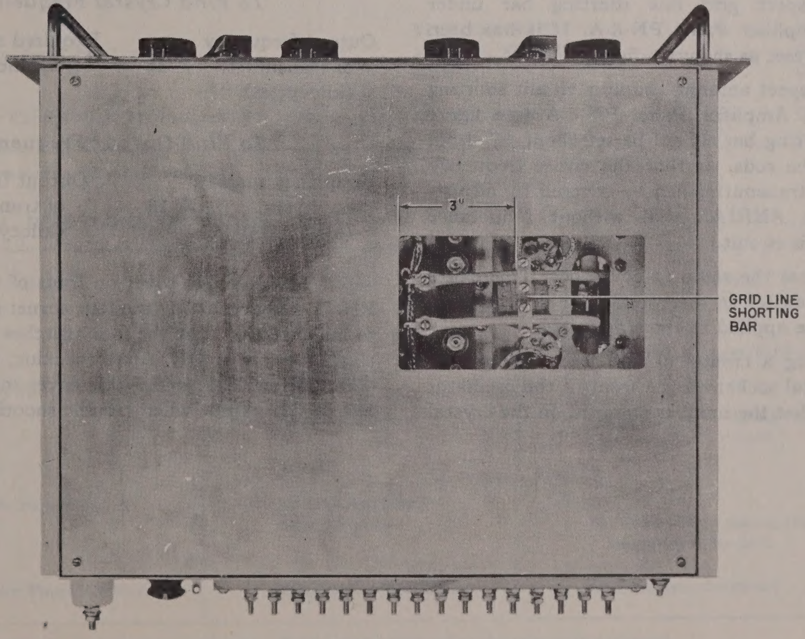


Figure 8—Amplifier Panel PN-8-A, and PN-8-B, Showing Grid Line Shorting Bar

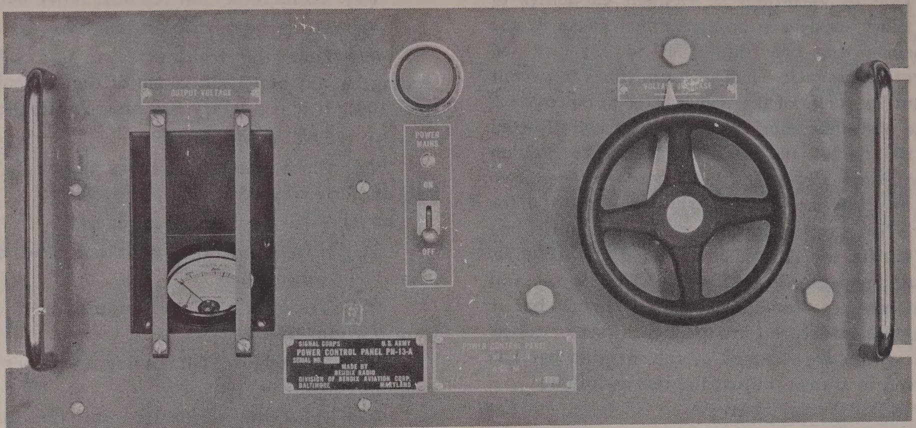


Figure 9 — Power Control Panel PN-13-A, Front View

(*a*) For 100 to 125 mc, ¼″ from stop on vertical portion of plate line.

(*b*) For 125 to 156 mc, ¼″ from stop on horizontal portion of plate line.

(*c*) For 125 mc, vertical portion just below bend.

(*d*) Inspect grid line shorting bar under chassis of Amplifier Panel PN-8-A. If it has been jarred loose, reset as shown in figure 8.

(*e*) Inspect antenna coupling circuit shorting bar (127) on Amplifier Panel PN-8-A (see figure 48). The shorting bar should be set about ⅜″ from the end of the rods, so that the entire frequency range of the transmitter can be covered by adjustment of the AERIAL dial without inductance changes in this circuit.

(*f*) Close the radio cabinet door. This closes the interlock switch in the transmitter so that plate voltage can be applied to the transmitter.

(*g*) Plug a crystal of the desired frequency into the crystal socket on the front of the oscillator panel. Note that the number stamped on the crystal is the fundamental oscillation frequency of the crystal, not the output frequency of the radio transmitter when operated with this crystal. Note also that the crystal frequency is given in kilocycles, while the transmitter output frequencies are in megacycles. One megacycle equals 1000 kilocycles.

To Find Crystal Frequency

Output frequency of transmitter (kilocycles) ÷ 18 = Required crystal frequency (kilocycles)

To Find Output Frequency

Frequency marked on crystal (kilocycles) X 18 = Output frequency of transmitter (kilocycles)

(*h*) Remove cover on front of Control Panel PN-11-A by removing the four corner screws. Check to make certain that the four switches located under this cover are at ON. After checking, replace cover. The four switches under this cover must always be left at ON except when trouble-shooting.

SECTION III

OPERATION

16. INITIAL SWITCH AND DIAL SETTINGS.

Set all switches and dials on the front of the transmitter to the positions given in the following tables.

NOTE

Careful, close adjustment of the tuning controls of Radio Transmitter BC-640-A, and BC-640-B, is essential for good results. Adjustments are most critical on the higher frequency portion of the tuning range. Tune, detune, and retune the transmitter several times to become familiar with each control. Watch the cathode current of the final amplifier when the TUNE-OPERATE switch is at OPERATE. DO NOT ALLOW THE CATHODE CURRENT TO EXCEED 75 MA FOR MORE THAN 5 SECONDS.

a. INITIAL POSITIONS OF SWITCHES.

Unit	*Switch*	*Position*
Amplifier Panel PN-8-A, -B	CATHODE CURRENT	C1
	GRID CURRENT	G1
	*Meter range, milliamperes	EXC-C
Oscillator Panel PN-9-A, -B	METER SELECTOR	CO
Modulator Panel PN-10-A, -B	REMOTE-LOCAL	LOCAL
Control Panel PN-11-A	TUNE-OPERATE	TUNE
	MASTER FILAMENT	OFF
	MASTER H.V.	OFF
Power Control Panel PN-13-A, and PN-13-B	POWER MAINS	OFF

*On Radio Transmitter BC-640-B only.

b. INITIAL POSITIONS OF DIALS.

Unit	*Dial*	*Setting*
Amplifier Panel PN-8-A	AERIAL	Detuned from operating frequency
	COUPLING	0
	NEUT.	50
	All other dials	Set according to tuning charts for frequency to be used
Oscillator Panel PN-9-A	T1	50
	NEUTRALIZING	50
	All other dials	Set according to tuning charts for frequency to be used
Modulator Panel PN-10-A	VOLUME CONTROL	OFF (counterclockwise)

NOTE: The initial dial settings are approximate. They may be changed as the transmitter is tuned.

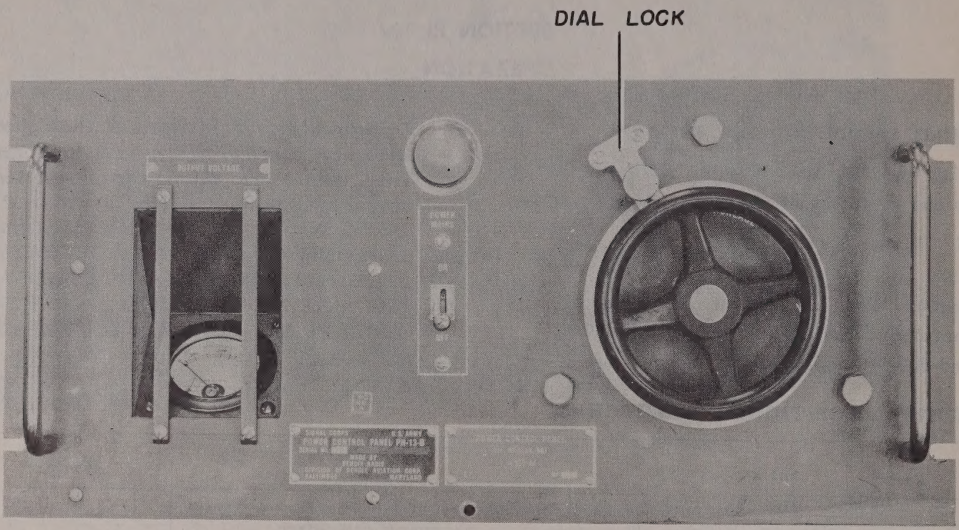

DIAL LOCK
SIGNAL CORPS U.S. ARMY
POWER CONTROL PANEL PN-13-B
MADE BY
BENDIX RADIO
DIVISION OF BENDIX AVIATION CORP.
BALTIMORE MARYLAND

Figure 10 — Power Control Panel PN-13-B, Front View

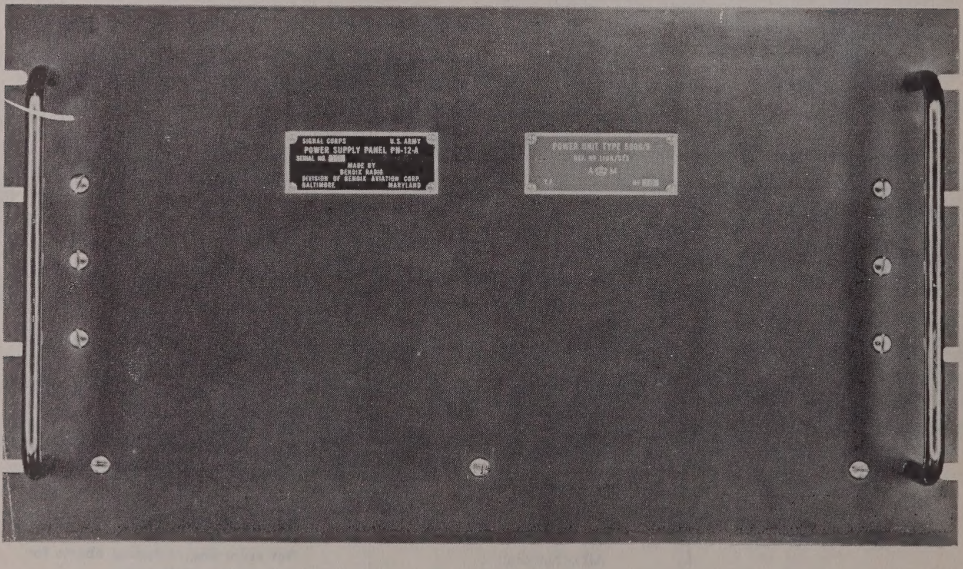

SIGNAL CORPS U.S. ARMY
POWER SUPPLY PANEL PN-12-A
SERIAL NO.
MADE BY
BENDIX RADIO
DIVISION OF BENDIX AVIATION CORP.
BALTIMORE MARYLAND
POWER UNIT TYPE 5000/3

Figure 11 — Power Supply Panel PN-12-A, Front View

17. TO TURN ON TRANSMITTER.

1. Close POWER MAINS switch
2. Close MASTER FILAMENTS switch
3. Wait one minute, then close MASTER H.V. switch

Keep output voltage meter on red line (230v) by adjusting voltage control wheel after each step

The pilot lamp on the power Control Panel PN-13-A should be lighted. If not, check line voltage supply. The pilot lamps on the Control Panel PN-11-A should also be lighted. Note that the R.F.H.V. lamp glows less brightly than the others when TUNE-OPERATE switch is at TUNE. At OPERATE, the R.F.H.V. lamp glows at full brilliancy.

18. TUNING.

Tune Oscillator Panel in the following order. Read each step through REMARKS before proceeding. *BE SURE THAT BOTH NEUTRALIZING LINES ARE OUT*. Separate charts are given here for Oscillator Panel PN-9-A and Oscillator Panel PN-9-B. BE SURE TO USE THE RIGHT CHART.

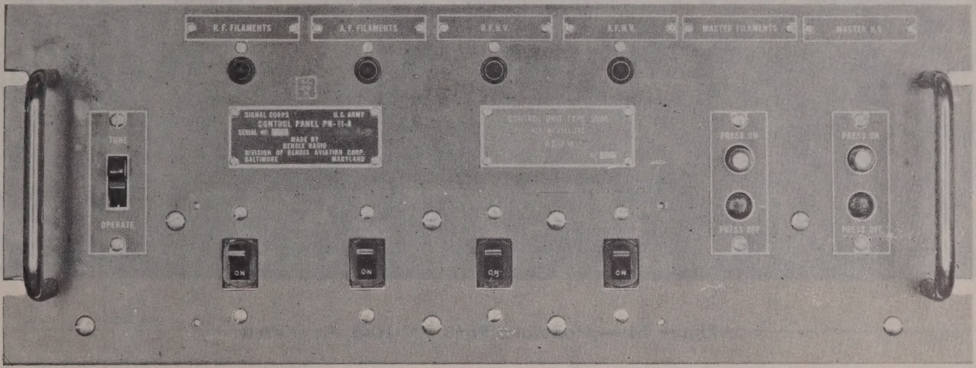

R.F. FILAMENTS
A.F. FILAMENTS
R.F.H.V.
A.F.H.V.
MASTER FILAMENTS
MASTER H.V.
TUNE
OPERATE
SIGNAL CORPS U.S. ARMY
CONTROL PANEL PN-11-A
SERIAL NO.
MADE BY
BENDIX RADIO
DIVISION OF BENDIX AVIATION CORP.
BALTIMORE MARYLAND
PRESS ON
PRESS OFF
ON
ON
ON
ON

Figure 12 — Control Panel PN-11-A, Front View

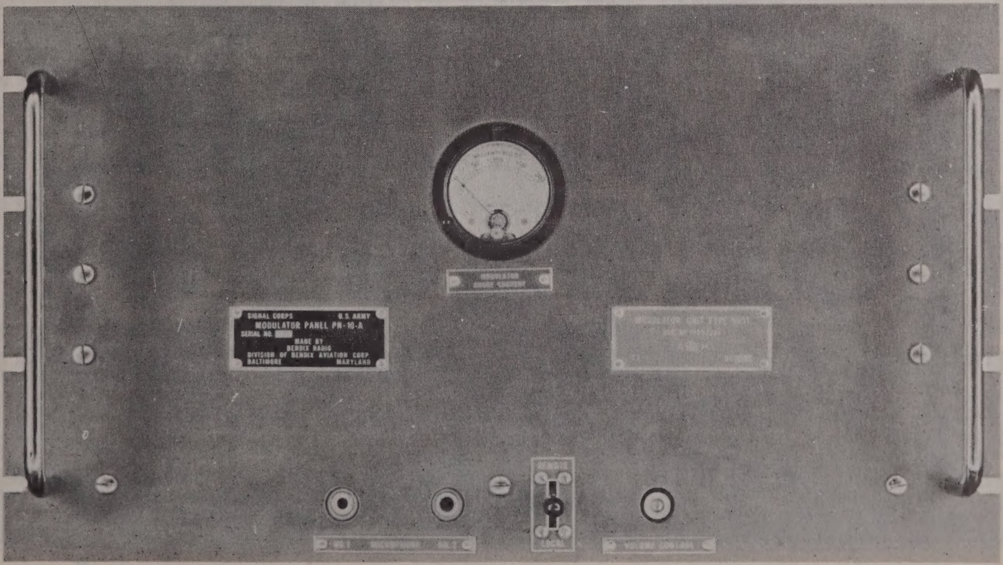

MODULATOR GRID CURRENT
SIGNAL CORPS U.S. ARMY
MODULATOR PANEL PN-10-A
SERIAL NO.
MADE BY
BENDIX RADIO
DIVISION OF BENDIX AVIATION CORP.
BALTIMORE MARYLAND
REMOTE
LOCAL
NO.1 MICROPHONE NO.2
VOLUME CONTROL

Figure 13 — Modulator Panel PN-10-A, Front View

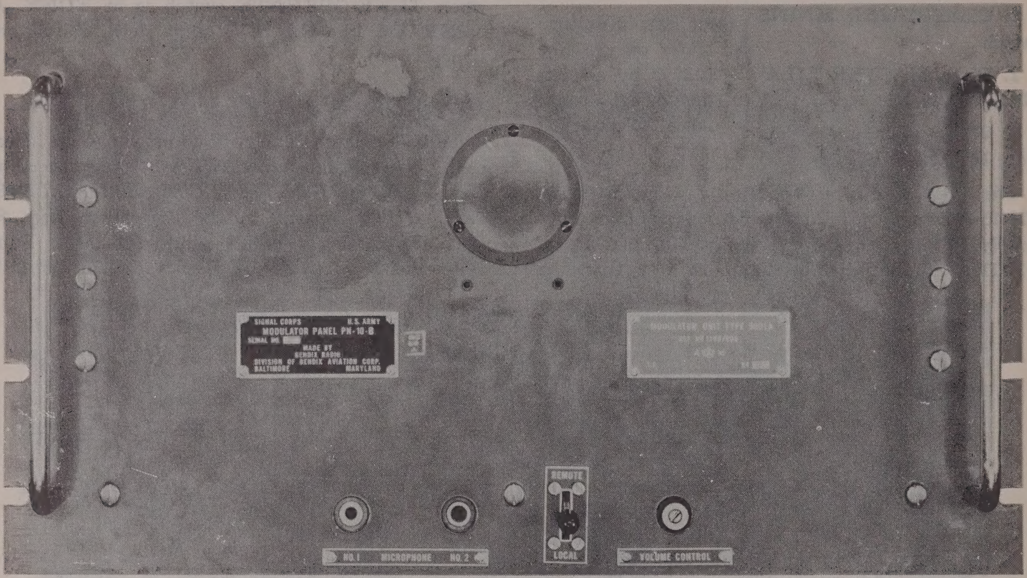

SIGNAL CORPS U.S. ARMY
MODULATOR PANEL PN-10-B
SERIAL NO.
MADE BY
BENDIX RADIO
DIVISION OF BENDIX AVIATION CORP.
BALTIMORE MARYLAND
MODULATOR UNIT TYPE 5015
REMOTE
LOCAL
NO.1 MICROPHONE NO.2
VOLUME CONTROL

Figure 14 — Modulator Panel PN-10-B, Front View

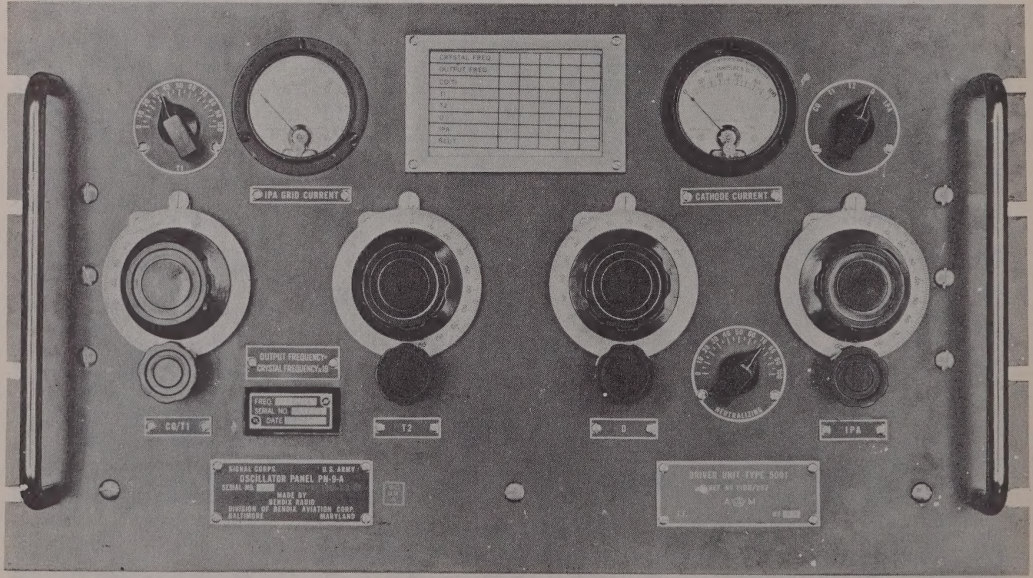

CRYSTAL FREQ.
OUTPUT FREQ.
CO/T1
T1
T2
D
IPA
NEUT.
T1
IPA GRID CURRENT
CATHODE CURRENT
CO T1 T2 D IPA
OUTPUT FREQUENCY=
CRYSTAL FREQUENCY x 16
FREQ.
SERIAL NO.
DATE
CO/T1
T2
D
NEUTRALIZING
IPA
SIGNAL CORPS U.S. ARMY
OSCILLATOR PANEL PN-9-A
SERIAL NO.
MADE BY
BENDIX RADIO
DIVISION OF BENDIX AVIATION CORP.
BALTIMORE MARYLAND
DRIVER UNIT TYPE 5001
A M

Figure 15 — Oscillator Panel PN-9-A, Front View

a. OSCILLATOR PANEL PN-9-A.

Step	*Tune Operate Switch*	*Meter Selector Switch*	*T1 Dial*	*Neutralizing Dial*	*CO/T1 Dial*	*T2 Dial*	*D Dial*	*IPA Dial*	*IPA Grid Current Meter*	*Cathode Current Meter*	*Remarks*
1	TUNE	CO			TUNE	.	.	.	.	Minimum	A minimum reading indicates resonance in the plate tank circuit.
2	OPERATE	CO	.	.	Increase reading toward 100 for an increase of 3-5 MA on meter	.	.	.	.	Increase 3-5 MA	This is most stable operating condition for the oscillator.
3	TUNE	T1	Tune	.	.	.	.			Minimum	
4	TUNE	T2	.	.	.	Tune	.			Minimum	Dial T2 should read within 15 divisions of dial CO/T1. Greater variation indicates dial T2 is tuned to wrong harmonic.
5	TUNE	D	.	.	.	.	Tune	.	3 to 5 MA or more	Minimum	Dial D reading should be approximately the same as dial T2 reading above. If IPA grid current is less than 6 MA, repeat steps 1 through 6.
6	OPERATE	D	.	.	.	.	.	Tune (note reading)	Minimum		Tune slowly and carefully as dip or minimum reading is very sharp. Minimum IPA grid reading indicates IPA plate tank is tuned to resonance (18 x crystal frequency) and that maximum energy transfer between grid and plate circuits is taking place through IPA grid-plate interelectrode capacitance. This grid-plate reaction requires neutralization.

a. OSCILLATOR PANEL PN-9-A (Continued)

Step	*Tune Operate Switch*	*Meter Selector Switch*	*T1 Dial*	*Neutralizing Dial*	*CO/T1 Dial*	*T2 Dial*	*D Dial*	*IPA Dial*	*IPA Grid Current Meter*	*Cathode Current Meter*	*Remarks*
7	OPERATE	D		Tune				Rotate through setting found above	Smallest deflection		Find setting for neutralizing dial giving smallest meter deflection when IPA dial is moved through resonance. This setting provides the correct external capacitance required to neutralize the IPA grid-plate interelectrode capacitance.
8	OPERATE	D					Re-tune	Set to resonance (setting of step 6)	Maximum		IMPORTANT—Steps 7 and 8 are repeated each time transmitter is neutralized.
9	OPERATE	D						Rotate through resonance	Smallest deflection		IPA stage neutralized if dip of IPA GRID CURRENT meter is small or if no dip. If not go back to step 7.
10	OPERATE	D						Set to resonance (setting of step 6)			
11			Set TUNE-OPERATE switch at TUNE—Turn OFF transmitter—replace oscillator panel neutralizing link at rear then turn ON transmitter as described in paragraph 17.								NOTE: Always turn OFF MASTER H.V. switch first when turning off transmitter.
12	TUNE	D					Re-tune		Maximum		
13	TUNE	IPA						Rotate through resonance	Maximum	Minimum	Maximum dip in cathode current and maximum IPA grid current should occur simultaneously. If not readjust neutralizing dial slightly. Large adjustments will require re-neutralizing; steps 7, 8, 9.
14	OPERATE	IPA						Set to resonance	Maximum	Minimum	

b. After the oscillator panel has been tuned, and the plate line shorting bar set, turn ON transmitter and tune the amplifier panel in the following steps in order given. Read each step through REMARKS before proceeding. DO NOT ALLOW CATHODE CURRENT METER TO READ HIGHER THAN 75 MA.

AMPLIFIER PANEL PN-8-A

Step	*Tune Operate Switch*	*Cathode Current Meter Switch*	*Amp. Grid Current Meter Switch*	*Neut. Dial*	*Aerial Dial*	*Coupling Dial*	*Anode Dial*	*Amp. Grid Dial*	*Cathode Current Meter*	*Grid Current Meter*	*Remarks*
1	OPERATE	C1	G1					Tune		Maximum	Amplifier grid current should be more than 8 MA.
2	OPERATE	C1	G1				Tune (note reading)			Minimum	This gives the ANODE dial setting for resonance in the power amplifier plate tank circuit (see par. 18*a* step 6).
3	OPERATE	C1	G1	Tune			Rotate through setting found above			Smallest deflection	Find setting for neutralizing dial giving smallest meter deflection when ANODE dial is moved through resonance. This setting provides the correct external capacitance required to neutralize the IPA grid plate interelectrode capacitance.
4	OPERATE	C1	G1				Set to resonance (Setting of step 2)	Re-tune		Maximum	IMPORTANT Steps 4 and 5 are repeated each time transmitter is neutralized.
5	OPERATE	C1	G1				Rotate through resonance			Smallest dip	Amplifier neutralized if dip of amplifier grid current is small or if no dip. If not repeat steps 3 and 4.
6	TUNE	Turn off transmitter. Replace amplifier neutralizing link at rear then turn on transmitter as described in paragraph 17.									Note: Always turn off MASTER H.V. switch first when turning off transmitter.
7	TUNE	C1	G1				Retune		Minimum (note reading)	Note reading	
8	TUNE	C2	G2						Above Reading 3 MA	Above Reading 3 MA	If meter readings of steps 7 and 8 vary more than 3 MA, VT-204 tubes are unbalanced and should be replaced.

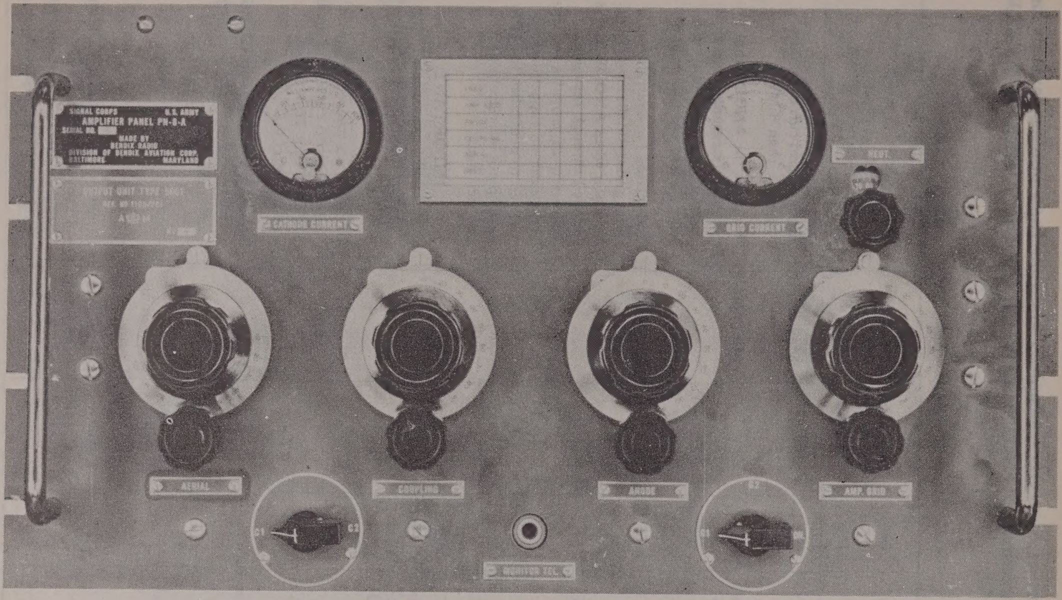

SIGNAL CORPS U.S. ARMY
AMPLIFIER PANEL PN-8-A
SERIAL NO.
MADE BY
BENDIX RADIO
DIVISION OF BENDIX AVIATION CORP.
BALTIMORE MARYLAND
CATHODE CURRENT
GRID CURRENT
AERIAL
COUPLING
ANODE
AMP. GRID
MONITOR TEL.
C1
C2
B2

Figure 16 — Amplifier Panel PN-8-A, Front View

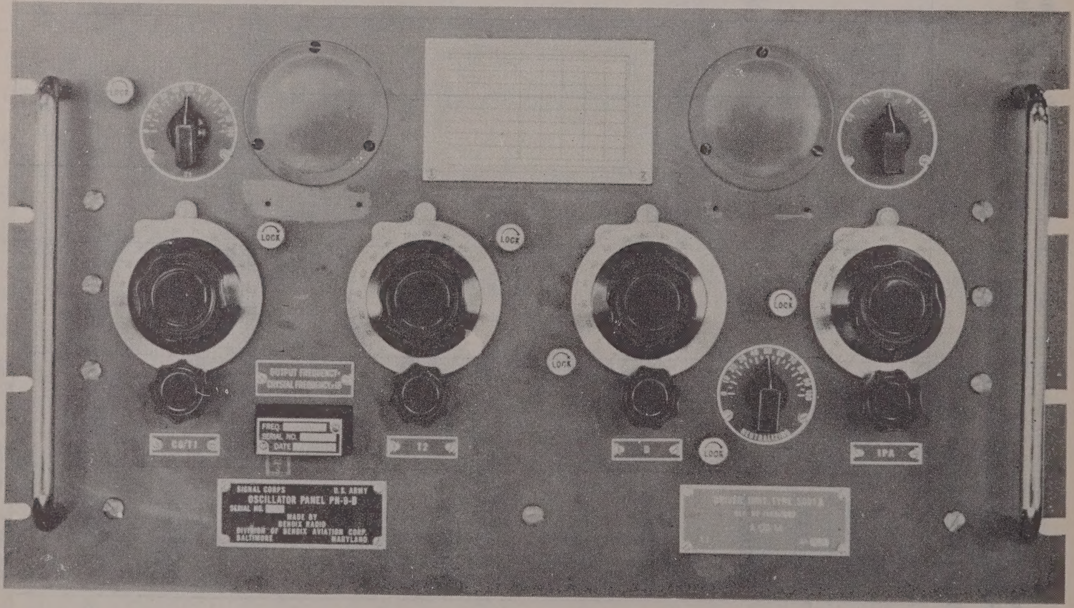

LOCK
LOCK
LOCK
LOCK
LOCK
LOCK
OUTPUT FREQUENCY
FREQ.
SERIAL NO.
DATE
CO/T1
T2
B
IPA
SIGNAL CORPS U.S. ARMY
OSCILLATOR PANEL PN-9-B
SERIAL NO.
MADE BY
BENDIX RADIO
DIVISION OF BENDIX AVIATION CORP.
BALTIMORE MARYLAND

Figure 17 — Oscillator Panel PN-9-B, Front View

b. AMPLIFIER PANEL PN-8-A (Continued)

Step	*Tune Operate Switch*	*Cathode Current Meter Switch*	*Amp. Grid Current Meter Switch*	*Neut. Dial*	*Aerial Dial*	*Coup-ling Dial*	*Anode Dial*	*Amp. Grid Dial*	*Cathode Current Meter*	*Grid Current Meter*	*Remarks*
9	TUNE	C1	G2				Retune		Minimum	Maximum	Maximum dip in cathode current and maximum amplifier grid current should occur simultaneously. If not, readjust NEUTralizing dial slightly. Large readjustments will require reneutralizing; see steps 3, 4, and 5. Be sure to remove neutralizing link when neutralizing.
10	OPERATE	Pull out crystal. Amplifier grid current meter should read zero. If it does not rotate amplifier neutralizing dial counterclockwise until meter reads zero. Repeat step 9. Replace crystal. Set coupling dial to 70.									If NEUTralizing dial is moved more than 5 dial divisions, reneutralize, (see steps 3, 4, and 5). Be sure to remove amplifier neutralizing link when neutralizing.
11	OPERATE	C1	G1	.	.	.	Retune	.	Minimum	.	KEEP CATHODE CURRENT UNDER 75 MA.
12	OPERATE	C1	G1	.	Tune	.	.	.	Maximum	.	
13	OPERATE	C1	G1	.	.	Tune	.	.	75 ma*	.	Check dial readings with tuning chart.
14	OPERATE	C1	G1	.	.	.	Retune	.	Minimum	.	Repeat step 13.
15	OPERATE		MON	.	.	.	.	.	.	3 ma or higher	Retune IPA dial on PN-9-A for maximum PN-8-A amplifier grid current with PN-8-A GRID CURRENT meter switch at G1.

*Approximately, the transmitter should be loaded until total cathode current for both output tubes minus total grid current for both output tubes equals 120 ma.

c. OSCILLATOR PANEL PN-9-B

Step	Tune-Operate Switch	Meter Selector Switch	T1 Dial	Neutralizing Dial	CO/T1 Dial	T2 Dial	D Dial	IPA Dial	On Amplifier Panel PN-8-B		Remarks
									Meter Range Milliamperes Switch	Meter	
1	TUNE	CO			Tune	.	.	.	EXC-C	Minimum	A minimum reading indicates resonance in the plate tank circuit.
2	OPERATE	CO		.	Increase reading toward 100 for an increase of 3-5 MA on meter	.	.	.	EXC-C	Increase 3-5 ma	This is most stable operating condition for the oscillator.
3	TUNE	T1	Tune	.	.	.	.	.	EXC-C	Minimum	
4	TUNE	T2	.	.	.	Tune	.	.	EXC-C	Minimum	Dial T2 should read within 15 divisions of dial CO/T1. Greater variation indicates dial T2 is tuned to wrong harmonic.
5	TUNE	D	.	.	.	.	Tune	.	EXC-C	Minimum	Dial D reading should be approximately the same as dial T2 reading above.
6	OPERATE	D	.	.	.	.	.	.	IPA-G	6 or more	If grid current is less than 6 ma, repeat steps through 6.
7	OPERATE	D	.	.	.	.	.	Tune (Note Reading)	IPA-G	Minimum	Tune slowly and carefully as dip or minimum reading is very small. Minimum IPA-Grid current reading indicates IPA plate tank circuit is tuned to resonance (18 x crystal frequency).

Step	*Tune-Operate Switch*	*Meter Selector Switch*	*T1 Dial*	*Neu-tralizing Dial*	*CO/T1 Dial*	*T2 Dial*	*D Dial*	*IPA Dial*	*On Amplifier Panel PN-8-B*		*Remarks*
									Meter Range Milliamperes Switch	*Meter*	
8	OPERATE	D	.	Tune	.	.	.	Rotate through setting found above	IPA-G	Smallest deflection	Find setting for neutralizing dial giving smallest meter deflection when IPA dial is moved through resonance. This setting provides the correct external capacitance required to neutralize the IPA grid-plate interelectrode capacitance.
9	OPERATE	D	.	.	.	.	Re-tune	Set to resonance (Setting of step 7)	IPA-G	Maximum	Important—Steps 9 and 10 are repeated each time transmitter is neutralized.
10	OPERATE	D	.	.	.	.	.	Rotate through resonance	IPA-G	Smallest deflection	IPA stage neutralized if dip of meter is small or if no dip. If otherwise go back to step 8.
11	OPERATE	D	.	.	.	.	.	Set to resonance (Setting of step 7)			
12		Set TUNE-OPERATE switch at TUNE, turn off transmitter, replace oscillator panel neutralizing link at rear, then turn on transmitter as described in paragraph 17.									NOTE: Always turn OFF MASTER H.V. switch first when turning OFF transmitter.
13	TUNE	D					Re-tune		IPA-G	Maximum	

c. OSCILLATOR PANEL PN-9-B (Continued)

Step	Tune-Operate Switch	Meter Selector Switch	T1 Dial	Neutralizing Dial	CO/T1 Dial	T2 Dial	D Dial	IPA Dial	On Amplifier Panel PN-8-B		Remarks
									Meter Range Milliamperes Switch	Meter	
14	TUNE	IPA	.	.	.	.	.	Rotate through resonance	IPA-G	Maximum	Maximum dip in cathode current and maximum IPA grid current flow should occur simultaneously. If not, readjust neutralizing dial slightly. Large adjustments will require reneutralizing; repeat steps 8, 9, and 10.
15	TUNE	IPA	.	.	.	.	.	Rotate through resonance	EXC-C	Minimum	
16	OPERATE	IPA	.	.	.	.	.	Set to resonance	IPA-G	Maximum	

d. After the oscillator panel has been tuned, and the plate line shorting bar set, turn on transmitter and tune the amplifier panel in the following steps and in order given. Read each step through "REMARKS" before proceeding. DO NOT ALLOW CATHODE CURRENT METER TO READ HIGHER THAN 75 MA.

AMPLIFIER PANEL PN-8-B

Step	Tune-Operate Switch	Cathode Current Meter Switch	Amp. Grid Current Meter Switch	Neut. Dial	Aerial Dial	Coupling Dial	Anode Dial	Amp. Grid Dial	Meter Range Milliamperes Switch	Meter	Remarks
1	OPERATE	C1	G1	.	.	.	.	Tune	PA-G	Maximum	Amplifier grid current should be more than 8 ma.
2	OPERATE	C1	G1	.	.	.	Tune (note reading)	.	PA-G	Minimum	This gives the ANODE dial setting for resonance in the power amp. plate tank circuit (see par. 18c step 7).

Step	*Tune-Operate Switch*	*Cathode Current Meter Switch*	*Amp. Grid Current Meter Switch*	*Neut. Dial*	*Aerial Dial*	*Coup-ling Dial*	*Anode Dial*	*Amp. Grid Dial*	*Meter Range Milliam-peres Switch*	*Meter*	*Remarks*
3	OPERATE	C1	G1	Tune	.	.	Rotate through setting found above		PA-G	Smallest deflection	Find setting for neutralizing dial giving smallest meter deflection when ANODE dial is moved through resonance. This setting provides the correct external capacitance required to neutralize the IPA grid-plate interelectrode capacitance.
4	OPERATE	C1	G1	.	.	.	Set to resonance (setting of step 2)	Re-tune	PA-G	Maximum	IMPORTANT Steps 4 and 5 are to be repeated each time transmitter is neutralized.
5	OPERATE	C1	G1	.	.	.	Rotate through resonance		PA-G	Smallest dip	Amplifier is neutralized if dip of amplifier grid current is small or if no dip. If not, repeat steps 3 and 4.
6	TUNE	Turn off transmitter. Replace amplifier neutralizing link at rear, then turn on transmitter as described in paragraph 17.									NOTE: Always turn off MASTER H.V. switch first when turning off transmitter.
7	TUNE	C1	G1	.	.	.	Retune		PA-G	Minimum (note reading)	
8	TUNE	C2	G1	.	.	.	.	.	PA-G	Note Reading	
9	TUNE	C2	G2	.	.	.	.	.	PA-C	Reading of step 7±3 ma	If readings of steps vary more than 3 ma, Tubes VT-204 are unbalanced and should be replaced.

AMPLIFIER PANEL PN-8-B (Continued)

Step	*Tune-Operate Switch*	*Cathode Current Meter Switch*	*Amp. Grid Current Meter Switch*	*Neut. Dial*	*Aerial Dial*	*Coupling Dial*	*Anode Dial*	*Amp. Grid Dial*	*Meter Range Milliamperes Switch*	*Meter*	*Remarks*
10	TUNE	C2	G2	.	.	.			PA-G	Reading of step 8±3 ma	
11	TUNE	C1	G2	.	.	.	Retune		PA-C	Minimum	Maximum dip in cathode current and maximum amplifier grid current should occur simultaneously. If not, readjust NEUTralizing dial slightly. Large readjustments will require reneutralizing (repeat steps 3, 4, and 5). Be sure to remove amplifier neutralizing link when neutralizing.
12	TUNE	C1	G2	.	.		Retune		PA-G	Maximum	
13	OPERATE	Pull out crystal. Amplifier grid current should be zero. If it is not, rotate amplifier neutralizing dial counterclockwise until meter reads zero. Repeat steps 11 and 12. Replace crystal. Set coupling dial to 70.									If NEUTralizing dial is moved more than 5 dial divisions, reneutralize (see steps 3, 4 and 5). Be sure to remove amplifier neutralizing link when neutralizin .
14	OPERATE	C1	G1	.		.	Retune	.	PA-C	Minimum	KEEP CATHODE CURRENT UNDER 75·MA.
15	OPERATE	C1	G1	.	Tune	.	.	.	PA-C	Maximum	
16	OPERATE	C1	G1			Tune	.	.	PA-C	75 ma*	Check dial readings with tuning chart.
17	OPERATE	C1	G1	.		.	Retune	.	PA-C	Minimum	Repeat step 16.
18	OPERATE		Mon			.		.	PA-G	3 ma or higher	Set **GRID** CURRENT meter switch at G1 and retune IPA dial (on PN-9-B) for maximum PN-8-B amplifier grid current.

*The transmitter should be loaded until total cathode current for both output tubes minus total grid current for both output tubes = approximately 120 MA.

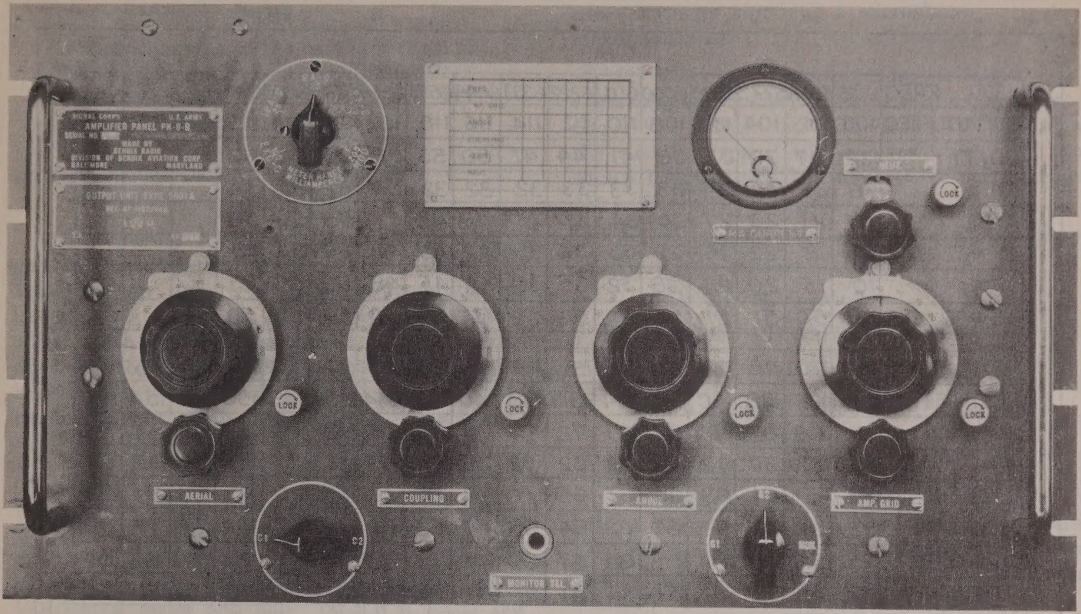

SIGNAL CORPS U.S. ARMY
AMPLIFIER PANEL PN-8-B
MADE BY BENDIX RADIO DIVISION OF BENDIX AVIATION CORP. BALTIMORE MARYLAND
METER READS MILLIAMPERES
LOCK
AERIAL
COUPLING
ANODE
AMP. GRID
MONITOR TEL.
C1
C2

Figure 18 — Amplifier Panel PN-8-B, Front View

e. RECORDING DIAL SETTINGS.—After the radio transmitter has been tuned for a particular frequency, record the dial settings and frequencies on one of the blank lamicoid charts located in a rear door compartment of the transmitter. Separate blanks will be found for the oscillator and amplifier panels. After writing in the dial readings, slide the chart into the holder on the front of the proper panel. Copies of blank charts as well as a typical numerical example are included with the transmitter and are shown here.

CAUTION

DO NOT USE THE NUMERICAL EXAMPLE FOR TUNING.

It shows an average of settings for ten transmitters, and is included only for your guidance.

Amplifier Panel Tuning Chart

FREQ.					
AMP. GRID					
ANODE					
COUPLING					
AERIAL					
NEUT.					

Oscillator Panel Tuning Chart

CRYSTAL FREQ.					
OUTPUT FREQ.					
CO/TI					
TI					
T2					
D					
IPA					
NEUT.					

XTAL FREQ	5555	5666	5777	5888	6000	6111	6222	6333	6444	6555	6666	6777	6888	6944			
OUTPUT FREQ.	100	102	104	106	108	110	112	114	116	118	120	122	124	125			
CO/T1	22	27	30	34	38	41	44	47	50	53	56	58	60	62			
T1	36	35	34	34	33	33	33	32	32	32	32	32	32	32			
T2	14	18	23	27	30	34	37	41	45	48	51	53	56	58			
D	15	18	22	26	29	33	36	39	42	45	48	50	52	53			
IPA	10	15	20	24	28	32	35	38	42	45	48	50	53	55			
NEUT.	50	50	51	51	51	52	52	52	52	52	52	52	52	52			

XTAL FREQ.	6944	7000	7111	7222	7333	7444	7555	7666	7777	7888	8000	8111	8222	8333	8444	8555	8667
OUTPUT FREQ	125	126	128	130	132	134	136	138	140	142	144	146	148	150	152	154	156
CO/T1	62	63	65	67	68	70	72	74	75	77	78	79	81	82	83	84	85
T1	32	32	32	32	32	32	32	32	32	33	33	33	33	33	33	33	33
T2	58	59	61	63	65	67	69	71	73	75	76	78	79	81	83	84	85
D	53	54	56	58	60	62	64	65	67	68	70	71	73	74	75	77	78
IPA	55	56	59	61	63	65	67	69	71	73	75	76	78	80	82	83	84
NEUT.	52	52	51	51	51	51	51	51	51	51	51	51	50	50	50	50	50

Oscillator Panel Tuning Chart, Numeral Example

FREQ.	100	102	104	106	108	110	112	114	116	118	120	122	124	125			
AMP. GRID	13	20	25	30	35	39	43	46	48	51	54	57	60	61			
ANODE	6	13	20	27	35	42	49	56	63	71	78	85	92	96			
COUPLING	50	51	51	52	52	53	53	54	54	55	55	55	55	55			
AERIAL	7	14	19	24	29	33	37	41	44	47	51	54	56	58			
NEUT.	65	65	66	66	66	66	66	65	65	65	65	65	65	64			

FREQ.	125	126	128	130	132	134	136	138	140	142	144	146	148	150	152	154	156
AMP. GRID	61	62	64	67	69	71	73	75	77	79	81	82	84	86	89	90	91
ANODE	6	9	14	20	26	32	38	43	50	55	60	66	72	78	84	89	95
COUPLING	51	52	53	54	54	56	57	58	59	60	61	63	64	65	65	65	65
AERIAL	58	59	62	64	67	70	72	75	78	80	82	84	86	88	90	92	94
NEUT.	65	65	65	65	64	64	64	64	63	63	63	63	62	62	61	60	59

Amplifier Panel Tuning Chart, Numerical Example

NOTE

If a vacuum tube in the oscillator panel or the amplifier panel is replaced, RETUNE THE TRANSMITTER AND CORRECT YOUR TUNING CHARTS.

19. OPERATION OF RADIO TRANSMITTER BC-640-A.

High-frequency equipment requires close adjustment of tuning control for efficient operation. Variations in supply voltage, temperature, or humidity may affect the performance of the transmitter. *Make the preliminary adjustments described in this paragraph each time the transmitter is turned on, and repeat them periodically during lengthy periods of operation.*

A slight readjustment of each control may be needed after the transmitter has warmed up, or when a wide variation in ambient (room) temperature occurs. The character of the transmitted signal may be checked by plugging a headset into the monitor jack on the amplifier panel. Check OUTPUT VOLTAGE meter and make certain it reads 230 volts (*red line*) before readjusting tuning controls.

a. LOCAL RADIO TELEPHONE OPERATION.

(1) Make certain REMOTE-LOCAL switch is at LOCAL.

(2) Plug microphone into one of MICROPHONE jacks on Modulator Panel PN-10-A.

(3) Speak into microphone in a normal tone of voice and adjust VOLUME CONTROL on the modulator panel with a screwdriver until the MODULATOR ANODE CURRENT meter reads 110 milliamperes on peaks.

(4) To cut the transmitter carrier off the air temporarily, open the MASTER H.V. switch.

(5) To turn OFF the transmitter completely, open power switches in the following order:

MASTER H.V. switch.
MASTER FILAMENTS switch.
POWER MAINS switch.

b. REMOTE RADIO TELEPHONE OPERATION.

(1) Set REMOTE-LOCAL switch at REMOTE. When the switch is at REMOTE, the transmitter high voltage will remain off until the remote operator turns it on by switching a microphone microphone line.

(2) When the remote operato is talkir. a microphone, connected across the remote microphone line, adjust the VOLUME CONTROL on the modulator panel with a screwdriver until the MODULATOR ANODE CURRENT meter reads 110 milliamperes on peaks.

(3) To turn the transmitter off, open the power switches in the following order:

MASTER H.V. switch.
MASTER FILAMENTS switch.
POWER MAINS switch.

c. LOCAL TELEGRAPH (MCW) OPERATION.

(1) Open POWER MAINS switch.

(2) Open rear door of transmitter and turn slotted Control (52) of modulator panel chassis clockwise all the way. Connect telegraph key across terminals 11 and 12 at the rear of the modulator Panel PN-10-A.

(3) Close and fasten rear door of the transmitter, closing the interlock switch.

(4) Make certain that REMOTE-LOCAL switch is at LOCAL.

(5) Turn Transmitter on [see paragraph 18*a*(3)].

(6) Press telegraph key and adjust VOLUME CONTROL on modulator panel until the MODULATOR ANODE CURRENT meter reads 108 milliamperes.

(7) To cut the transmitter carrier off the air temporarily, open the MASTER H.V. switch.

(8) To turn the transmitter off, open power switches in the following order:

MASTER H.V. switch.
MASTER FILAMENTS switch.
POWER MAINS switch.

d. REMOTE TELEGRAPH (MCW) OPERATION.

(1) Open POWER MAINS switch.

(2) Open rear door of transmitter and turn slotted control (52) on top of modulator panel chassis clockwise all the way.

(3) Connect one pair of field wire across terminals 11 and 12 at rear of Modulator Panel PN-10-A. Extend the field wire from the transmitter

to a telegraph key located at the controller's position next to Control Unit RM-26-A at the Operations Center.

(4) Close and fasten rear door of transmitter, closing the interlock switch.

(5) Turn the transmitter on (see paragraph 17).

(6) When the remote operator presses down the correct RADIO (red) pushbutton and places the SEND-RECEIVE key on Control Unit RM-26-A to SEND, the transmitter carrier will be on the air.

(7) Now, when the remote operator presses the telegraph key, you adjust the VOLUME CONTROL on the modulator panel until the MODULATOR ANODE CURRENT meter reads 108 milliamperes.

(8) The remote operator cuts the transmitter carrier off the air by placing the SEND-RECEIVE key on Control Unit RM-26-A to RECEIVE.

(9) To turn the transmitter off completely, open power switches in the following order:

MASTER H.V. switch.
MASTER FILAMENT switch.
POWER MAINS switch.

e. CHANGING FREQUENCY.—To change the operating frequency of the transmitter, it is necessary to completely retune the transmitter. Directions for determining crystal frequency are given in paragraph 15.

CHECK POSITION OF PLATE LINE SHORTING BAR AS DESCRIBED IN PARAGRAPH 15.

20. OPERATION OF RADIO TRANSMITTER BC-640-B.

High frequency equipment requires close adjustment of tuning controls for efficient operation. Variations in supply voltage, temperature, or humidity may affect the performance of the transmitter. Make the preliminary adjustments described in this paragraph each time the transmitter is turned on, and repeat them periodically during lengthy periods of operation.

a. PRELIMINARY ADJUSTMENTS.—Before operating Radio Transmitter BC-640-B, check dial settings with data recorded in paragraph 15c.

(1) Set COUPLING dial at 100.

A slight readjustment of each control may be necessary after the transmitter has warmed up, or when a wide variation in ambient (room) temperature occurs. The character of the transmitted signal may be checked by plugging a headset into the monitor jack on the amplifier panel. Check OUTPUT VOLTAGE meter and make certain it indicates 230 volts (red line) before readjusting tuning controls.

b. LOCAL RADIO TELEPHONE OPERATION.

(1) Make certain REMOTE-LOCAL switch is set at LOCAL.

(2) Plug microphone into one of MICROPHONE jacks on Modulator Panel PN-10-B.

(3) Set METER RANGE-MILLIAMPERES switch at MOD.

(4) Speak into microphone in a normal tone of voice and adjust VOLUME CONTROL on the modulator panel with a screwdriver until the meter indicates 110 milliamperes on peaks.

(5) To cut the transmitter carrier off the air temporarily, open the MASTER H.V. switch.

(6) To turn off the transmitter completely, open power switches in the following order:

MASTER H.V. switch.
MASTER FILAMENTS switch.
POWER MAINS switch.

c. REMOTE RADIO TELEPHONE OPERATION.

(1) Set REMOTE-LOCAL switch to REMOTE. When the switch is at REMOTE, the transmitter high voltage will remain off until the remote operator turns it on by switching a microphone across the microphone line.

(2) Set METER RANGE-MILLIAMPERES switch at MOD.

(3) When the remote operator is talking into a microphone connected across the remote microphone line, and while he is talking into it, adjust the VOLUME CONTROL on the modulator panel with a screwdriver until the meter reads 110 milliamperes on peaks.

(4) To cut the transmitter carrier off the air temporarily, open the MASTER H.V. switch.

(5) To turn the transmitter off completely, open power switches in the following order:

MASTER H.V. switch.
MASTER FILAMENTS switch.

POWER MAINS switch.

d. LOCAL TELEGRAPH (MCW) OPERATION.

(1) Open POWER MAINS switch.

(2) Open rear door of transmitter and turn slotted control (52) on top of modulator panel chassis clockwise all the way. Connect telegraph key across terminals 11 and 12 at the rear of the modulator panel.

(3) Close and fasten rear door of the transmitter, closing the interlock switch.

(4) Make certain that REMOTE-LOCAL switch is at LOCAL.

(5) Turn the transmitter on (see paragraph 17).

(6) Set METER RANGE-MILLIAMPERES switch at MOD.

(7) Press key, and adjust VOLUME CONTROL on modulator panel until meter indicates 108 ma.

(8) To cut the transmitter carrier off the air temporarily, open the MASTER H.V. switch.

(9) To turn the transmitter off completely, open power switches in the following order:

MASTER H.V. switch.
MASTER FILAMENTS switch.
POWER MAINS switch.

e. REMOTE TELEGRAPH (MCW) OPERATION.

(1) Open POWER MAINS switch.

(2) Open rear door of transmitter and turn slotted control (52) on top of modulator panel chassis clockwise all the way.

(3) Connect one pair of field wire across terminals 11 and 12 at rear of Modulator Panel PN-10-B. Extend the field wire from the transmitter to a telegraph key located at the controller's position next to Control Unit RM-26-A at the Operations Center.

(4) Close and fasten rear door of transmitter closing the interlock switch.

(5) Turn the transmitter on (see paragraph 17).

(6) When the remote operator presses down the correct RADIO (red) pushbutton and places the SEND-RECEIVE key on Control Unit RM-26-A to SEND, the transmitter carrier will be on the air.

(7) Now, when the remote operator presses the telegraph key, you adjust the VOLUME CONTROL on the modulator panel the meter reads 108 milliamperes, with the METER RANGE-MILLIAMPERES switch set at MOD.

(8) The remote operator cuts the transmitter carrier off the air by placing the SEND-RECEIVE key on Control Unit RM-26-A to RECEIVE.

(9) To turn the transmitter off completely open power switches in the following order:

MASTER H.V. switch.
MASTER FILAMENT switch.
POWER MAINS switch.

f. CHANGING FREQUENCY.—To change the operating frequency of the transmitter, it is necessary to completely retune the transmitter as described in paragraphs 15, 16, 17, and 18. Directions for determining crystal frequency are given in paragraph 15. CHECK POSITION OF PLATE LINE SHORTING BAR AS DESCRIBED IN PARAGRAPH 15.

SECTION IV
MECHANICAL AND ELECTRICAL CHARACTERISTICS

21. COMPONENT PARTS.

a. AMPLIFIER PANEL PN-8-A.—This is the final amplifier stage of the transmitter and is at the top of the transmitter rack. It supplies about 50 watts of radio frequency power to a concentric cable with a characteristic impedance of 72 ohms. Two tubes, Tube VT-204 are operated as a class C amplifier. One tube, Tube VT-94 provides a rectified monitor signal (see figures 61 and 62).

b. OSCILLATOR PANEL PN-9-A.—This provides the radio frequency to drive the final amplifier at the operating frequency. The final output frequency is obtained by multiplication from crystals whose frequencies are between 5555.5 and 8666.6 kilocycles. Tube VT-175 or VT-66 is used as the oscillator, operating on the fundamental frequency of the crystal. The oscillator feeds Tube VT-100 tripler which drives Tube VT-204 and operates as a second tripler. The second tripler drives Tube VT-204 operated as a doubler, and the doubler drives Tube VT-204 operated as an intermediate power amplifier. The power output to the final is about 15 watts.

c. MODULATOR PANEL PN-10-A.—This provides high-level modulation for the final power amplifier. It uses two tubes, Tube VT-94 in the input as a push-pull voltage-amplifier stage. Two tubes, Tube VT-175 or Tube VT-66 follow as a push-pull driver stage, driving two tubes, Tube VT-217 as a class B modulator. Tube VT-94 is used as a 1,000-cycle audio oscillator for test of modulation or to key the transmitter. The output power is sufficient to modulate the transmitter with 100% voice or a 1,000-cycle tone signal. Either remote or local voice input can be selected by a switch on the front panel. Provisions are made for keying the 1,000-cycle audio oscillator.

d. CONTROL PANEL PN-11-A.—This contains ON-OFF switches for plate and filament supplies to all the components of the radio transmitter. The high voltage contactor and two control relays are mounted on the chassis. A 24-volt d-c power supply

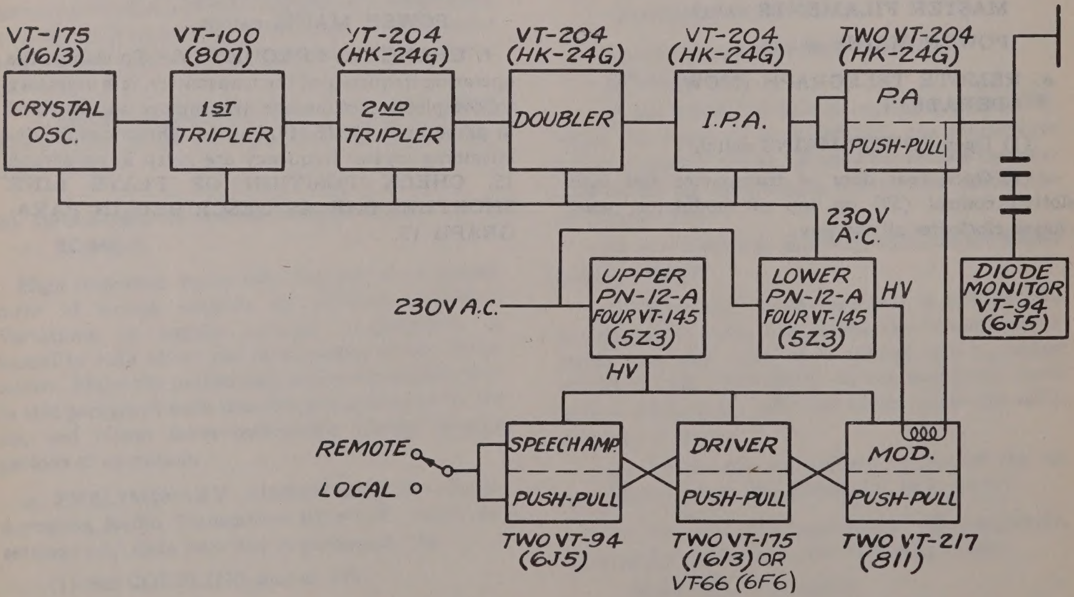

VT-175
(1613)
CRYSTAL OSC.
VT-100
(807)
1ST TRIPLER
VT-204
(HK-24G)
2ND TRIPLER
VT-204
(HK-24G)
DOUBLER
VT-204
(HK-24G)
I.P.A.
TWO VT-204
(HK-24G)
P.A
PUSH-PULL
230V A.C.
230V A.C.
UPPER
PN-12-A
FOUR VT-145
(5Z3)
LOWER
PN-12-A
FOUR VT-145
(5Z3)
HV
HV
DIODE MONITOR
VT-94
(6J5)
REMOTE
LOCAL
SPEECH AMP
PUSH-PULL
DRIVER
PUSH-PULL
MOD.
PUSH-PULL
TWO VT-94
(6J5)
TWO VT-175
(1613) OR
VT-66 (6F6)
TWO VT-217
(811)

Figure 19 — Radio Transmitter BC-640-A, and BC-640-B, Block Diagram

using a selinium rectifier is also included on the control panel to provide low d-c voltage for the operation of relays and remote-signal lights of the transmitter.

e. POWER SUPPLY PANEL PN-12-A.—There are two Power Supply Panels PN-12-A used. One provides all the plate supply for Panel PN-8-A and Panel PN-9-A and the other supplies Modulator Panel PN-10-A. All filament power is obtained from individual filament transformers mounted on the amplifier, oscillator and modulator panels. Each power supply uses four tubes, Tube VT-145 (rectifier) in a bridge-type circuit, it providing terminal potentials of about 330, 395, and 800 volts d-c.

f. POWER CONTROL PANEL PN-13-A.—This controls the line voltage to the transmitter. It consists of line fuses, main switch, voltmeter to measure the voltage to transmitter, and a variable-ratio transformer, which can be controlled from the front of the panel. A 110-125 or 220-250 volts a-c supply can be used by changing the line terminal connections at the rear of the panel. The voltage supplied to the rest of the transmitter from the power control panel is set at 230 volts. Figure 19 shows a block diagram of the transmitter.

g. CABINET CS-88-A.—This cabinet acts as a frame for holding all the panels of the transmitter and also as a shield. A single door in the rear permits access to all panels of the radio transmitter. There are cooling louvers, screened on the inside to exclude insects in the sides, top and rear of the transmitter. The cabinet has a door interlock switch which disconnects the line voltage to the transmitter when the door is open. The switch closes when the door closes. Five compartments are provided on the rear door for the following:

(1) Master tuning charts for Amplifier Panel PN-8-A.

(2) Master tuning charts for Oscillator Panel PN-9-A.

(3) Blank front panel tuning charts for Amplifier Panel PN-8-A.

(4) Blank front panel tuning charts for Oscillator Panel PN-9-A.

(5) Overall schematic drawing and parts list.

The front of the cabinet permits rack mounting of the transmitter components. All panels of the transmitter may be removed from the front for repair, replacement, or service, by disconnecting all leads at the rear and removing the mounting screws in front.

22. OSCILLATOR PANEL PN-9-A CHARACTERISTICS.

a. CRYSTAL OSCILLATOR STAGE.—The frequency of the crystals range from 5555.5 to 8666.6 kilocycles. The crystals are plugged into the socket through a rectangular hole in the lower left-hand side of the front panel. *It makes no difference which way the crystal is plugged in.* A 15-mmf zero-coefficient ceramicon capacitor (175), in parallel with the crystal, is used so that the same oscillator input capacitance is used as in the airplane Radio Set SCR-522, therefore the crystal-oscillator output frequency will be the same. Grid bias for the oscillator tube is produced by a 100,000-ohm two-watt grid resistor (188). The oscillator tube, Tube VT-175 or VT-66 is a commercial type 1613 tube. The 9 to 106-mmfd oscillator-tuning capacitor (163-1) in series with a .002-mfd 1000-volt fixed mica capacitor (164) acts as a band-spread capacitor. The tuning capacitor is coupled to a dial on the front panel and marked CO/T1. The positive plate-voltage lead to the oscillator stage is by-passed to ground with a .005-mfd 1000-volt mica capacitor (162-1). Series plate feed is used. Voltage for the screen grid is developed through a 50,000-ohm 2-watt series resistor (190-1) from the plate voltage supply. The screen grid is bypassed to ground with a .005-mfd 600-volt mica capacitor (161-4) and the cathode is bypassed to ground with a .005-mfd 600-volt mica capacitor (161-1).

Each filament terminal of the oscillator and first tripler tubes are bypassed to ground with .005-mfd 600-volt mica capacitors (161-2-3-6-7). The oscillator output frequency should be the same as the crystal frequency. When tuning this stage, the capacitor should be varied until the minimum cathode current is obtained, then increase the dial reading about two degrees or until the cathode current is increased about two milliamperes. This will be the most stable operating condition of the oscillator.

b. FIRST TRIPLER STAGE.—In the second stage tube, Tube VT-100 (807) is used and serves as a first tripler. This is a beam power tube and is well adapted for use as a harmonic amplifier. Since little excitation is required to drive this tube, a mid-tap on the oscillator plate coil (178) is capacitively coupled to the grid of this tube through a 50-mmfd 1000-volt mica capacitor (165-1). By using a mid-tap on the oscillator coil the oscillator circuit will not be upset easily and enough excitation can be obtained. When excitation is applied, grid bias is developed through a 25,000-ohm 2-watt resistor (191-1). Cathode bias is also used to provide some self-bias through a 1,000-ohm 15-watt resistor (192-1) and to prevent the tube from being damaged when no excitation is available, by keeping the plate dissipation within its rating.

A 9 to 106-mmf tuning capacitor (163-2) is in parallel with the plate coil (179). The shaft of this tuning capacitor is coupled with an insulated bushing to the shaft of the oscillator tuning capacitor. This makes the tuning easier, quicker, and there is no possibility of tuning to the wrong harmonic frequency. To check the tuning of this stage, a 2.8 to 8.5-mmf padder capacitor (167) is in parallel with the main tuning capacitor (163-2) and has its control knob directly above the CO/T1 dial and is marked T1. Always tune this control for minimum current of the VT-100 stage. The screen voltage for this tube is developed through a 50,000-ohm 2-watt series resistor (190-2).

The plate voltage lead is bypassed to ground with a .002-mfd 2500-volt mica capacitor (166-1). The output frequency range of this stage is three times that of the crystal-oscillator stage or about 16,666 to 26,000 kilocycles. Individual plate voltage leads are connected to separate terminals on the terminal board for easy servicing.

c. SECOND TRIPLER STAGE.—The third stage is a tripler and uses Tube VT-204 (3C 24/HK-24-G). This tube is used in preference to Tube VT-100 because of the higher frequency-range and more stable operation on this frequency of Tube VT-204. The grid of this tube is coupled through a .0005-mfd 5000-volt mica capacitor (168-1) from the plate of the first tripler tube. Grid bias is obtained when excitation is applied through a 25,000-ohm 2-watt resistor (191-2) and a grid radio-frequency choke (180). The grid resistor is bypassed to ground with a .002-mfd 500-volt mica capacitor (169-1). The plate voltage is shunt-fed through the plate choke coil (182) from terminal 15 on the terminal board. Self-bias is obtained from the center-tap (6) of the filament transformer to ground through a 1000-ohm 15-watt resistor (192-2), and a 50-ohm 2-watt resistor (189-3). Capacitors 169-2 and 169-3 bypass the filament.

The plate circuit of this stage is tuned with a 7 to 48-mmf capacitor (170) and a three-turn ⅛-inch silver-plated copper-tubing coil (181), ¾ of an inch in diameter. This tuning capacitor is coupled with an insulated bushing to a dial marked T2. A plate blocking capacitor .002-mfd 2500-volt mica (166-3) prevents the high voltage from being applied to the tuned circuit and allows excitation to the following stage. The output frequency from this stage should be nine times the crystal frequency or approximately 50 to 78 megacycles.

d. DOUBLER STAGE.—The fourth stage is a doubler and uses Tube VT-204 (3C24/HK-24-G). Grid bias for this tube is obtained by two series 7,500-ohm 2-watt resistors (193-1, 193-2). Since one 2-watt resistor cannot dissipate the required power and in order to keep this 2-watt standard, two similar resistors are used. These resistors are bypassed to ground with a .005-mfd 1000-volt mica capacitor (162-2). No filament center-tap bias is used on this stage because with the 395 maximum volts on the plate and no excitation to this stage, the rated plate dissipation will not be exceeded.

Shunt plate voltage feed is also used for this stage through a radio-frequency choke (183) and terminal 16. The plate-voltage lead on the cold side of the radio-frequency choke (183) is bypassed to ground with a .005-mfd 1000-volt mica capacitor (162-3). The plate blocking capacitor (168-2) is a .0005-mfd 5000-volt mica capacitor. This stage is tuned with a dual or split-stator 2.5 to 35-mmf per section capacitor (171) in parallel with a four-turn 1/8-inch silver-plated copper-tubing coil (184), ½-inch inside diameter and one inch long. This capacitor (171) is coupled to a control dial on the front panel marked D. The output frequency from this stage should be eighteen times the crystal frequency or approximately 100 to 156 megacycles.

e. INTERMEDIATE POWER AMPLIFIER STAGE.—Coupling to the intermediate power-amplifier Tube VT-204 (3C24/HK-24-G) is slightly different from that of the previous stages. One side of the doubler tuning coil and capacitor is coupled directly to the grid of this stage. Bias is developed through two 5,000-ohm 2-watt resistors (194-2, 194-1) in series with the center-tap of the doubler tuning coil (184) and a 0 to 25 milliammeter (186) to ground. The milliammeter is bypassed directly at the terminals of the meter with a .02-mfd 1,000-volt mica capacitor (174-2). The low-voltage side of the grid resistor (194-2) is also bypassed to ground, but with a .002-mfd 500-volt mica capacitor (169-6). This stage uses a transmission line-type tank-coil (185) consisting of a 15-inch length of ¼-inch outside diameter silver-plated copper tubing bent to form a U. Spacing of this line is 1⅛ inches from center to center. The plate tuning capacitor (172) is a dual, variable capacitor 5 to 27 mmf per section and coupled to a dial on the front panel marked IPA. Since a triode tube is used in the amplifier stage it must be neutralized. Plate neutralization is used and tuned with a neutralizing capacitor (173) of 1.9 to 3.0 mmf. The neutralizing-capacitor shaft is coupled to an isolantite and bakelite coupler, a shaft, and a control knob on the front panel (marked NEUT.)

The plate voltage for this stage is approximately 800 volts and enters through terminal-bushing 17, a neutralizing link, a radio-frequency choke coil (159), and another radio-frequency choke coil (177) shunted with a 500-ohm 2-watt resistor (158) to the center tap of the IPA tank-coil (185). The reason for using an additional radio-frequency choke-coil (177) and shunted with a resistor (158) is to suppress parasitics which might otherwise be present.

The IPA plate-choke bypass capacitor (168-3) is a .0005-mfd 5000-volt mica capacitor. When neutralizing this stage provision is made to remove the high voltage by removing a link at the rear of the chassis marked NEUT. LINK. With no excitation to this stage the grid resistors would not develop any grid bias and the rated plate dissipation would be exceeded. Therefore center-tap (12) filament bias is used. This is a 125-ohm 15-watt resistor (195) which may be connected through fuse-type clips from transformer center-tap (12) through resistor (189-5), 50-ohm 2-watt, to ground. The two filament terminals at the socket are bypassed to ground with .002-mfd 500-volt mica capacitors (169-4, and 169-5).

The r-f output of this stage is approximately 15 watts. Without this stage it would be impossible to supply sufficient excitation to the final Amplifier Panel PN-8-A. The output frequency from this stage should be eighteen times the crystal frequency or 100 to 156 megacycles. A grid milliammeter is connected permanently in the grid circuit of this stage because it will be considerably easier to neutralize.

This chassis contains a filament transformer (196) with the primary terminals connected to terminals 4 and 5 on the terminal board. The primary winding is to be used for 230 volts, 50 to 60-cycle input at 67 volt-amperes. Four secondary windings are used to supply 6.3 volts for each of the five tubes The two cathode tubes (Tube VT-175 or VT-66 and Tube VT-100) have their filament leads connected in parallel. The remaining three tubes are supplied from individual windings.

A 0-100 cathode milliammeter (187) is used to tune the five stages. This meter is used with a 5-point, single-pole, non-shorting wafer-type switch (176). The meter is bypassed with a .02-mfd 600-volt mica capacitor (174-1). Either the cathode or filament center-tap on the transformer of each tube is in series with a 50-ohm, 2-watt, meter-shunt resistor (189-1-2-3-4-5). The designation for the cathode meter switch is identical with the markings under each control knob, that is CO/T1, T2, D, IPA. With this method one meter will be satisfactory for measuring the cathode current of each stage. *It should be remembered that cathode current is a combination of grid and plate current.*

The radio-frequency coils and choke coils are placed in certain positions on the chassis so that no interaction exists between any of them. All the coils, which are made of copper tubing, are silver-plated to prevent corrosion. The bypass capacitors are grounded to points where they are most effective. Due to the fact that the tank coil of the IPA stage is in a position to provide inductive coupling to Power Amplifier Panel PN-8-A, there is an additional shield along the side of this unit to prevent any stray field. Figure 40 shows a top view of this panel.

23. AMPLIFIER PANEL PN-8-A CHARACTERISTICS.

a. Two tubes, Tube VT-204 (3C24/HK-24-G) operate in push-pull with a long-line grid inductance (135) and a long-line plate inductance (136). With this panel in the cabinet and the fixed position of the long-line grid inductance, it is partially in parallel to the long-line tank inductance (185) of the IPA stage on Oscillator Panel PN-9-A. This provides inductive coupling for the r-f excitation necessary to drive this stage. This coupling is not too critical. In order to prevent any stray coupling from Oscillator Panel PN-9-A to Amplifier Panel PN-8-A there is a solid metal shield on the bottom of the amplifier panel with a hole cut in it to allow only the necessary coupling. The grid inductance consists of two 7-inch sections of ¼-inch diameter silver-plated copper tubing bent to form an L. The amount of inductance is determined by the position of the .005-mfd 1000-volt mica grid-shunt capacitor (127). It is placed across the grid lines at a point at which the grid tuning capacitor (128) will tune a 100-mc signal at about 7 on the dial and a 156-mc signal will tune at about 98 on the dial. The grid-tuning capacitor

(128) is a dual, variable capacitor of 3.3 to 32-mmf per section. It is connected across the grid tuning lines close to the grids of tubes, Tube VT-204. The rotor is not grounded.

This grid tuning capacitor is coupled through an insulated bushing to a control dial on the front panel marked GRID. The position of the grid-shunt capacitor may be varied after loosening four screws. A capacitor is used for the grid shunt so that individual grid current readings may be noted. The capacitor will pass radio frequencies but not the d-c rectified grid current.

When excitation is applied to this stage, grid bias is developed through two 3,000-ohm 2-watt resistors (145-1, 145-2) and four 14,000-ohm 2-watt resistors (144-1-2-3-4). The two grid leak resistors (145-1, 145-2) act as radio-frequency chokes. Two of each of the 14,000-ohm resistors are connected in parallel because one resistor does not dissipate the required power. In this way the 2-watt size resistor will be standard. The cold side of the grid-leak resistors (145-1, 145-2) is bypassed to ground for radio frequency with .0005-mfd 1000-volt mica capacitors (126-1, 126-2).

The filament terminals at the tube socket of each tube are bypassed to ground for radio frequencies through .005-mfd 600-volt mica capacitors (121-1-2-3-4). The plate-tank inductance (136) is composed of two sections 15 inches long, ¼-inch diameter, silver-plated copper tubing and bent to form an L.

The plate circuit is tuned with a special concentric type dual capacitor (129) of approximately 23-mmf total capacity. It is made of brass, and is silver-plated. It connects the lines about 2¾ inches from the plate leads of the tubes. An eccentric cam arrangement is coupled to the plate tuning capacitor and to a control dial on the front panel marked ANODE. The eccentric cam is arranged so that variations of the ANODE tuning dial cause the plate capacitor to be varied in approximately a straight-line frequency curve.

This stage is tuned to resonance by obtaining the minimum cathode current. The d-c plate voltage is fed from terminal 17 on the rear of the chassis through the neutralizing link and an r-f choke coil (134-1) shunted with a 500-ohm 2-watt resistor (141-2) to the junction of the tuning lines. The 500-ohm resistor (141-2) is in parallel with the radio-frequency choke coil to prevent any parasitic oscillations. The cold side of the radio-frequency coil is bypassed to ground with a .0047-mfd 5000-volt mica capacitor (125).

To tune the plate circuit from 100 to 156 mcs, the length of the tuning lines must be changed so that the band is divided into two sections. When tuning from 100 to 125 mcs the shorting bar is used on the vertical portion of the tuning line and placed ¼ inch from the filister head screws. When tuning from 125 to 156 mcs the plate line shorting bar is in the horizontal portion of the line and ¼ inch from the fillister head screws. By using the long-lines plate inductance, a higher efficiency and more stabilized circuit will result. The position of the plate-line shorting bar may be varied after loosening the thumb nuts with your fingers. *No tools are necessary for the change.*

The range of the plate-tuning capacitor will be spread over almost the entire ANODE dial for each setting of the tuning bar. Since this is an amplifier circuit and triode tubes are used, they must be neutralized. Two neutralizing capacitors are connected with an insulated bushing and then to another insulated bushing and shaft, and to the neutralizing dial on the front panel. The procedure for neutralizing these tubes is identical to that of the IPA stage. The neutralizing link is on the rear of the chassis and marked NEUT. LINK. This stage is likewise tuned for minimum cathode or filament current.

In order to couple the r-f output to the antenna plug, a long-lines type of link is used. This link is tuned with a dual 3.5 to 17.5-mmf-per-section capacitor (130) with the rotor grounded. This capacitor is tuned for the maximum cathode current by varying the AERIAL dial on the front panel, then the antenna link (137) is varied with the COUPLING dial on the front panel until the cathode current meter indicates 60 milliamperes per tube plus the grid current per tube. Coupling to the antenna terminal is made with a loop of 1/16-inch copper tubing which is inductively and directly coupled to the tuned loop (137, 138). This additional coupling loop is used to better match the transmitter output to the transmission line with a more consistent output over the entire frequency range.

The filaments of the three tubes on this chassis are supplied by a filament transformer (146) with a 230-volt input winding (terminal 1 to terminal 4 and terminal 2 to terminal 5 on the terminal board). There are three secondary windings which supply 6.3 volts at the required current for each tube. The

0 to 100 cathode milliammeter (140) is in series with the chassis and the single-pole, two-position meter switch (150). The two terminals on the cathode meter switch are connected to the center-tap of each winding of the filament transformer (146). Two 50-ohm 2-watt resistors (143-1, 143-2) are in series permanently with the center of each of these windings. These resistors are used as meter shunts. A grid milliammeter, 0 to 25 scale, (139) and a single-pole, three-position grid-meter switch (149) is used to measure the grid current of each stage individually. The two 50-ohm 2-watt resistors (143-3, 143-4) are used as meter shunts. Both of these meters are bypassed with .02-mfd 1000-volt mica capacitors (132-1, 132-2).

In order to check the voice output of the transmitter and to provide an over-modulation indicator, Tube VT-94 (6J5) is used as a diode rectifier monitor. Filament power for this tube is supplied by the third secondary winding (terminals 3-4) of the filament transformer. The two filaments and the cathode terminals, at the socket, are bypassed with .001-mfd 1000-volt mica capacitors (122-1-2-3). The grid and plate terminals are connected through two 1.5-mfd 1000-volt low-loss mica capacitors (123-1, 123-2) in series with the antenna terminal. By using two capacitors in series a high breakdown voltage is obtained and enough r-f will be fed to the grid and plate terminals. By using the least possible capacitance this circuit will affect the antenna circuit the least.

The purpose of the monitor Tube VT-94 is to rectify a small amount of the radio-frequency carrier to obtain the audio component. Three identical radio-frequency choke coils (134-2, 3, 4) are used to prevent any radio-frequency from seeping through to the monitor output terminals. Capacitors (122-4, 5, 6) are .001-mfd 1000-volt mica capacitors, and are used to prevent any stray r-f from entering the output terminals. The cathode is connected through the radio-frequency choke coil (134-4) and a 500-ohm 2-watt monitor-load resistor (141-1) to ground.

The rectified current may be checked by placing the grid-meter switch (149) at the MON. The meter shunt for this circuit is a 50-ohm 2-watt resistor (143-5).

The audio output may be checked by placing a pair of headset terminals in the monitor jack (133), and also may be checked from terminal (10) on the terminal board to chassis with a headset. This terminal (10) is connected to terminal (39) on the cabinet terminal board for the remote monitor line.

The monitor-blocking capacitor (124) is a .1-mfd 600-volt oil-filled capacitor which allows the audio signal to pass, but blocks any direct current voltage. When the MONITOR TEL. jack is not used, the contacts are shorted to ground, therefore a series 5,000-ohm 2-watt resistor (142) is used. This prevents a direct short for the monitor-load resistor (141-1) so that the signal may be monitored at a remote point. See figure 47 for a top view of this panel.

24. MODULATOR PANEL PN-10-A CHARACTERISTICS.

a. INPUT.—The modulator panel PN-10-A is the third panel from the top of the cabinet CS-88-A. Its use is to amplify voice at normal input levels or a 1000-cycle audio tone signal, and provide for 100-per cent high-level plate modulation for the final power amplifier on panel PN-8-A. The input is provided for either remote or local speech operation and is selected by a lever key on the front panel.

A shielded transformer (60) supplies the filaments of the seven tubes on the chassis. The primary is wound for 230 volts, 50/60 cycles at 69 volt-amperes. Primary terminal 1 of this transformer is connected to terminal 5 and terminal 2 to terminal 4 on the terminal board. There is an electrostatic shield between the primary and secondary windings. The transformer is insulated for 1500 volts (rms) between all windings and to ground.

Number one secondary terminals 5 and 7 deliver 6.3 volts center-tapped (6) at 8 amperes or 50 volt-amperes, and supplies the filaments of the two VT-217 (811) modulator tubes.

Number two secondary terminals 3 and 4 supply the two tubes, Tube VT-175 (1613) or tubes, Tube VT-66 (6F6). They are rated 6.3 volts at 1.4 amperes or 9.4 volt-amperes.

Number three secondary terminals 8 and 9, rated 6.3 volts at 1.3 amperes or 8.8 volt-amperes, supply the three tubes, Tube VT-94 (6J5).

There are two types of input; local and remote. The local input is used with Microphone T-48-A (single-button) which may be plugged into jack (No. 1). The British microphone BT-23 (single-button) may be plugged into jack (No. 2). The two jacks have 2-conductor contacts for tip and ring.

The sleeve is not used for a contact. The two jacks are connected in series and bypassed with .0005-mfd midget mica capacitors (31-1, 31-2, 31-3 and 31-4) to eliminate any stray radio-frequency pick-up.

The remote line input is connected from terminals 13 and 14 on the terminal board to the lever key (55). Terminals 13 and 14 are connected externally through the interpanel wiring cable to terminals 36 and 37 on the cabinet terminal board in the rear of the bottom of the cabinet. (See figures 6, 24, 60, 61 and 62). Terminals 15 and 16 on the terminal board are connected through the interpanel wiring cable to terminals 23 and 24 of the control panel PN-11-A which supplies power for the microphone. All of the four input lines are bypassed at the terminals on the board to ground with midget .0005-mfd mica capacitors (31-5, 31-6, 31-7 and 31-8).

The LOCAL-REMOTE switch (55) is a locking one-way lever key. It has six sets of make-and-break contacts of the anti-capacitance type.

The primary of the microphone transformer (56) is 600-ohms impedance (terminals 1 to 6) with center-tap leads (3 and 4) from each half brought out to individual terminals. Each half is tapped (2 to 5) for a total impedance of 100 ohms. The microphone voltage is brought to the two center-taps (3 and 4) of the transformer. These two taps (3 and 4) are bypassed for speech frequencies with a 2-mfd 600-volt capacitor (37). The primary then acts as a single winding as far as pulsating currents are concerned. There is an electrostatic shield between the primary and secondary windings. All of the six taps on the primary are bypassed directly at the terminals to ground with .0005-mfd midget capacitors (31-24, to 31-29 inclusive) as a prevention of stray radio-frequency pick-up.

When the LOCAL microphone is used, two 200-ohm ½-watt input resistors (45-1, 45-2) are connected in series with the lever key and the center tap-leads (2 and 5) on each half of the primary of the microphone transformer, and resistors (45-1, 45-2) are used to attenuate the input. However, when the remote microphone line is used, slightly more input will probably be needed to have a more uniform input level with the local microphone.

The secondary winding of the microphone transformer has a total impedance of 30,000 ohms to feed push-pull grids. The response is 3 db variation from 200 to 4,000 cycles. All transformers which carry direct current are designed to carry, without damage to themselves or any other part of the equipment, at least 25 per cent more direct current than the maximum they will carry in normal usage. The secondary of the microphone transformer is shunted with a dual volume control (53). This volume control is a dual unit for a push-pull circuit. Each unit has 15,000 ohms, taper B, and a clockwise resistance increase from front of panel. There is a screwdriver slot which is used for adjustment of this control. This control is on the lower right side of this modulator panel.

Two first-audio grid filter resistors (46-1, and 46-2) 10,000 ohms at ½ watt are used as an audio filter. All audio stages are used in push-pull to produce the characteristic desired and eliminate the undesirable effects of using single tubes in cascade. Push-pull stages produce less harmonic output with increased gain. The filaments of all audio tubes, both cathode and filament types, are bypassed to ground directly at the tube sockets with .0005-mfd mica capacitors (31-10 to 31-23)

b. SPEECH AMPLIFIER STAGE.—The first push-pull stage uses a pair of VT-94 (6J5) high-mu metal-type triode tubes. The cathodes of these tubes are connected together and in series to ground through a 500-ohm 2-watt resistor (50). Approximately 8 volts of cathode bias should be developed. Both of these cathodes are bypassed to ground directly at the tube socket with .0005-mfd mica capacitors (31-14, 31-15). Across the grid to cathode of each of these tubes a capacitor audio filter is used which is composed of one .002-mfd (33) and one .0001-mfd (32) capacitor. The .0001-mfd capacitors (32-1, 32-2) are soldered directly to the tube socket terminals while the .002-mfd capacitors (33-1, 33-2) are mounted on a subchassis. The direct current voltage at the plates of the tubes, Tube VT-94 (6J5) is about 250 volts.

The tubes, Tube VT-94 are used because of their rating as class A amplifiers. These tubes have sufficient gain to increase the input level sufficiently to drive a pair of tubes, Tube VT-175 (1613) or tubes, Tube VT-66 (6F6) in push-pull. All of these stages are transformer coupled. The first interstage transformer (57) has a push-pull input and output. The plate voltage for the VT-94 is fed through the center-tap (2) of this interstage transformer (57) and bypassed with a 4-mfd 600-volt capacitor (38-1). The secondary of this transformer is shunted on each side to ground with grid load resistors (47-1, 47-2) 50,000-ohms ½-watt.

c. DRIVER STAGE.—Since low plate-load resistance tubes are desirable for the purpose of driving class B tubes, the tubes, Tube VT-175 or VT-66, are connected as triodes with the plate and screen tied together. A low-voltage filter choke (43) is connected from the low-voltage input terminal (7) 330 volts to the center-tap (2) of the interstage transformer (57). This choke is rated 30 henries at .025 amperes d-c, 870-ohms d-c resistance. It is tested at 1,500 volts (rms) at 60 cycles and used to filter the 330-volt plate supply. It lowers the voltage for the tubes, Tube VT-94 (6J5), and prevents interaction between stages. The center-tap (2) of interstage transformer (57) to the tubes, Tube VT-94, is filtered with a 4-mfd 600-volt capacitor (38-1).

The interstage transformer (58) couples the push-pull VT-175 or VT-66 plates to the push-pull VT-217 grids. With 100-percent tone-modulation of the final radio-frequency amplifier the VT-217 direct grid current measured from center-tap (5) of input transformer (58) to ground is .015 amperes. There is an electrostatic shield between the primary and secondary. The plate voltage for the tubes, Tube VT-175 or VT-66, is fed through the center-tap (2) of the interstage transformer (58) from terminal 7 on the terminal board. This driver plate voltage is bypassed with a 4-mfd 600-volt capacitor (38-2).

d. MODULATOR STAGE.—A pair of push-pull tubes, Tube VT-217 (811), high-mu, are used as zero bias class B modulators. Since the plate voltage is approximately 850 volts d-c, no bias is necessary and the center-tap of the driver transformer is grounded. The output modulation transformer (59) is used for push-pull output to a 5,700-ohm load.

A 0-200 milliammeter (44) is in series with the center-tap (6) of the filament transformer and grounded at all times. *The name plate for the meter is marked* ANODE CURRENT *but actually indicates grid and plate current.* The static current of these tubes should be about 40 milliamperes with the 850 volts d-c on the plate. The meter is bypassed with a .02-mfd 1,000-volt d-c mica capacitor (39). There are three terminals (17, 18, 19) on ceramic bushings on the rear of this chassis. Terminal 17 has a potential of 850 volts d-c to chassis as supplied by the modulator Power Supply Panel PN-12-A. Terminal 18 has a potential of 800 volts d-c to chassis as supplied from the radio-frequency Power Supply Panel PN-12-A. Terminal 19 is the modulation output terminal and has a d-c potential of 800 volts plus the audio voltage necessary to modulate the radio-frequency power amplifier 100 per cent. This is a peak voltage of 800 volts a-c or 566 volts a-c (rms). The plate voltage for the plates of the VT-175 or VT-66 is connected to terminal 7 on the terminal board. Terminals 1, 2 and 11 on the terminal board are ground.

e. 1,000-CYCLE OSCILLATOR STAGE.—The tone oscillator on this chassis may be used to modulate the power amplifier 100 per cent at 1,000 cycles for modulated continuous waves. Tube VT-94 (6J5) is used as a simple triode series-fed Hartley audio oscillator. The audio oscillator transformer (61) has two windings, the primary inductance is 5.7 henries at 1,000 cycles and the turns ratio of primary to secondary is 10 to 1 with a power level of 5.2 db.

The B plus supply is fed to a tap (2) on the transformer. The audio oscillator grid blocking capacitor (34) is .02-mfd 1000-volt d-c which isolates the B plus supply from the grid and allows the grid to develop its own bias. The grid bias is obtained from the grid leak (48) of 1 megohm, ½ watt.

The audio-oscillator series resistor (49) is 50,000 ohms, 2 watts, and determines the magnitude of oscillation. The oscillator tank capacitor (35) determines the frequency of oscillations and must be fairly accurate, therefore it has a low temperature coefficient and is rated .0045 mfd, 1000 volts d-c. The oscillator output is fed from the secondary winding of the transformer (61) at terminals 4 and 5 and shunted with a dual 600-ohm potentiometer (52). This potentiometer has a clockwise resistance-increase control with a screwdriver slot for adjustment. The output is fed to the secondary terminals (7, 9) of the microphone input transformer (56) through the keying relay (42). This is a quick-acting relay with 100 ohms d-c resistance and operates on 4 to 5.5 volts d-c. It is capable of making 12 pulses per second. The direct current supply for the relay is produced with a selenium half-wave rectifier (54) from the oscillator filament supply of about 6 volts. Capacitors 36-1 and 36-2 (25 mfd) form the filter for the 6 volts.

25. CONTROL PANEL PN-11-A CHARACTERISTICS.

This control panel is used to switch on the filament and plate supplies to the panels of the transmitter. It contains switches, control relays, fuses, pilot lamps, a transformer and selenium rectifier to supply direct current for the microphone and signal lamp. A terminal board with twenty-eight terminals is used for all connections to this panel. Primary a-c supply voltage for the various plate and filament transformers, all pilot-lamp voltages and the rectifier output voltage may be checked on this terminal board.

To operate the transmitter 230 volts a-c must be supplied to terminals 1 and 2 on the terminal board. These two lines are connected from the load terminals 5 and 6 on the terminal board of Power Control Panel PN-13-A. Two 5-ampere fuses (2-1, 2-2) are in series with the supply terminals to the double-pole, single-throw, push-button, and **MASTER FILAMENTS** switch (13-1) rated 250 volts at 10 amperes. With this switch closed voltage will be supplied to the **MASTER HV** switch (13-2), filament switches (15-1, 15-2) and primary of the rectifier transformer. The filament-supply fuses (4-1, 4-2) are cartridge-type fuses rated 250 volts at 2 amperes.

The **R.F. FILAMENT** switch (15-1) controls the **ON-OFF** filament supply to terminals 11 and 12 for the filaments on Oscillator Panel PN-9-A, Amplifier Panel PN-8-A and Power Supply Panel PN-12-A that supplies the oscillator and amplifier plate supply. When the **MASTER FILAMENTS** switch is closed, voltage will be applied to the **MASTER HV** switch (13-2). Now the **MASTER HV** switch (13-2), which has the same rating as the **MASTER FILAMENTS** switch, should be closed. Voltage is now applied to one side of the high-voltage contactor coil (6). This high-voltage contactor relay coil is wound for 230 volts and has two normally open, 110-volt, 15-amperes, 60-cycle contacts. The relay is operated by the plate control relay (8). The plate control relay will not function unless the interlock switch on the cabinet is closed. The interlock switch connects to terminals 25 and 26 on the terminal board.

The interlock switch is a single-pole, normally open, momentary-contact switch rated 250 volts at 3 amperes. With the high-voltage contactor (6) closed, voltage will be applied to the **A.F.H.V.** and **R.F.H.V.** switches (15-3, 15-4) through high-voltage fuses (3-1, 3-2). These high-voltage fuses (3-1, 3-2) are rated 250 volts at 3 amperes.

The six cartridge fuses are placed in the clips which are on the terminal boards and are plainly marked for easy replacement. The **R.F.H.V.** switch (15-3) controls the **ON-OFF** plate-supply power to the radio-frequency panels through a **TUNE-OPERATE** switch (14). The **A.F.H.V.** switch (15-4) controls the plate-supply power to terminals 19 and 20 on the terminal board for Modulator Panel PN-10-A.

The **TUNE-OPERATE** switch (14) is a single-pole, double-throw, tumbler switch rated 250 volts at 5 amperes. It is on the left-hand side of the panel. The four switches (15-1, 15-2, 15-3, 15-4) are double-pole, single-throw, flush-type tumbler switches rated 250 volts at 10 amperes and are normally switched **ON** and left in that position. These switches are mainly used for service work on the transmitter so that individual units may be switched on. When in normal use, there will be a cover plate over these switches held in place by four screws with tapped holes in the panel.

There are four switchboard-type pilot-lamps on this panel. These pilot lamps, (10-1, 10-2, 10-3, 10-4), are tubular and rated 4 volts at .210 amperes. In order to remove these lamps a special tool must be used. First remove the lamp cap then with a special tool remove the lamp. The special tools are supplied in the tool kit. These lamps get their filament supply from separate windings on transformers of the respective panels through terminals 3 to 10 on the terminal board. These lamps will be lighted when the control switches are **ON**. When the **TUNE-OPERATE** switch (14) is at **TUNE** the **R.F.H.V.** pilot lamp will be about one-half brilliancy. Inasmuch as power for the pilot lamps is supplied from a separate winding on each of the respective transformers they will show if the primary winding is supplied with power. However, the pilot light may be out and still there may be high voltage supplied to the respective panels or the high voltage may be open and the pilot lights on.

With only the **MASTER FILAMENTS** switch (13-1) **ON**, power will be supplied to primary terminals 1 and 2 of the rectifier transformer (16). This primary is wound for 230 volts at 16 volt-amperes. The secondary voltage should be 27 volts on terminals 3 to 4, 29 volts on terminals 3 to 5, and 31 volts on terminals 3 to 6 at 16-volt amperes. Normally terminals 3 and 4 are used.

The transformer secondary winding supplies alternating-current voltage to a full-wave bridge-type selenium rectifier (12) rated 24 volts direct-current at .460 amperes. The selenium rectifier is capable of delivering a well-regulated power output.

The negative output is grounded to the chassis. In the positive lead a filter is used to smooth the rectified output for the microphone and control-relay supply. This is a brute-force (single-section capacitor input) type of filter consisting of a 20-mfd, 50-volt electrolytic-input capacitor (1-1), a filter choke (9) rated 15 henries at .08 amperes d-c in series with the positive lead and another capacitor (1-2) with the same rating as the input capacitor (1-1) across the output of the supply.

A bleeder resistor (11) rated 120 ohms at 30 watts is connected directly across the output of the selenium rectifier. The positive output lead from the selenium rectifier is connected to terminal 22 on the terminal board through the contacts of the signal control relay (7). The output from the filter-choke is connected through the plate-control relay (8) to terminal 24 on the terminal board. The signal-control relay (7) has one set of standard break contacts and a coil resistance of 100 ohms. The plate-control relay (8) has two sets of heavy-duty make contacts and a coil resistance of 200 ohms. When the lever key (55) on the modulator panel is at **LOCAL**, the plate-control relay (8) will be energized by connecting terminal 24 through the microphone transformer (56) and local microphone, if used, to terminals 23, then through the signal-control relay (7) to ground and terminal 21.

The rectifier will not serve as a power-supply for the microphone and an additional filter is used. This additional filter consists of the plate-relay coil in series with the positive lead and two additional 20-mfd 50-volt electrolytic capacitors (1-3, 1-4) across the output. One set of heavy-duty contacts on the plate-control relay is used to connect the additional capacitors in the circuit. The other set of heavy-duty contacts closes the circuit for the high-voltage contactor providing the **MASTER HV** switch (13-2) and the interlock switch on the cabinet are closed. Since current is flowing through the signal-control relay (7) this coil is energized and the contacts will open and remove the supply for the remote signal lamps.

For remote operation when the **REMOTE-LOCAL** switch (55) on the modulator panel is at **REMOTE**, a microphone may be inserted in the line and between terminals 36 and 37 on the terminal board at the base of the cabinet. The plate relay (8) will close when a microphone and a 200-ohm resistor is in series with the terminals 36 and 37. This will switch on the transmitter. Terminal 23 will be grounded through the lever key on the modulator panel and the signal relay will not operate, therefore the signal lamp will be lighted during remote operation. See figure 20.

26. POWER SUPPLY PANEL PN-12-A CHARACTERISTICS.

a. LOW VOLTAGE SUPPLY.—The primary of the filament transformer (97) is wound for 230 volts, 50/60 cycles, 61 volt-amperes. Primary terminals 1 and 2 of the filament transformer are connected to terminals 4 and 5 on the terminal board. There are four secondary windings, two of which are identical and rated 5 volts center-tapped at 15 volt-amperes. The third winding has a rating of 30 volt-amperes and is otherwise identical to number one and two windings. Secondary winding number four, rated 4 volts at 1 volt-ampere, supplies power for the filament pilot-lamp and is connected to terminals 10 and 11 on the terminal boards. Windings one, two and three supply the filaments of the four tubes, Tube VT-145 (5Z3). Three filament windings are necessary because with the bridge type of rectifier, all of the filaments are not at the same direct current potential. The primary winding is insulated for 1,500 volts (rms) to ground. Secondary windings number one, two and three are insulated for 400 volts (rms) to ground and to all other windings, while the number four winding is insulated for 1,000 volts (rms).

b. HIGH-VOLTAGE SUPPLY.—The high-voltage plate transformer (98) has a primary winding for 230 volts, 50/60 cycles, 350 volt-amperes and is extended for half-voltage at one-quarter of the total watts. The primary transformer terminals 1, 2 and 3 are connected to terminals 1, 2 and 3 respectively on the terminal board. The power-supply which supplies Modulator Panel PN-10-A has no external connection to this terminal board and terminal 1 is not used. The radio-frequency power-supply makes use of the extended winding and is connected to the **TUNE-OPERATE** switch (14) on Control Panel PN-11-A. This switch is used to reduce the maximum high voltage to approximately one-half for the two radio-frequency panels as a protection when tuning the transmitter.

Two hash-filter capacitors (93-1, 93-2) are used to bypass each side of the primary high-voltage transformer (98) terminals, 2 and 3, to ground. These are foil-paper, oil-impregnated, rated at 0.1-mfd, 600-volt capacitors. These capacitors may eliminate some hash from going back over the alternating-current line and causing interference.

The secondary of the high-voltage transformer is rated 1,025 volts center-tapped at 386 volt amperes. The total direct-current resistance of this winding should not exceed 60 ohms. This secondary is insulated for 4,000 volts (rms) to all other windings and to ground. The other secondary winding on this transformer is rated 4 volts at 1 volt-ampere and insulated for 1,000 volts (rms). Terminal 4 of this transformer is connected to terminal 13, and terminal 5 to terminal 12 on the terminal board.

Four tubes, Tube VT-145 (5Z3) (high-vacuum tube rectifiers), are connected in a bridge circuit. The output to terminals 16 and 17 is supplied by an ordinary full-wave rectifier with the high direct-current potential at terminal 17 and the low potential at terminal 16. In ordinary power-supply applications the center-tap of the high-voltage transformer is at ground potential. However, in this case the center-tap is not grounded.

Output to terminals 14 and 16 is also supplied by a full-wave rectifier. In this case the two filaments (99-3, 99-4) are at opposite high potentials and the plates are connected and grounded. The rectifier action is the same in both cases since the load current in the tube flows from the filament to the plate.

The Tubes VT-145 (5Z3) deliver a maximum of 225 milliamperes per tube with 550 volts a-c per plate (rms) using choke input filter. By using the high-vacuum type of tube instead of a mercury vapor tube there is less danger of arc back and faulty starting of the rectifiers in certain climates. The rectifiers for the high-voltage side of the direct-current output have one of the plates of one tube (99-1) connected to the tap (6) on one end of the high-voltage transformer winding and also to one plate of the other rectifier tube (99-2). The other end (tap 8) of this winding is connected to the remaining plate of each tube. In this way two plates are connected in parallel and will pass the required current with a better margin of safety. By connecting the plates of these tubes in this way there is less load on each tube at the same instant than if the two plates of the same tube were connected in parallel.

The other two rectifiers (99-3, 99-4) have the two plates of each tube connected in parallel and these plate leads connected to ground. The filaments of each of these tubes have separate filament supplies and the center-tap of each winding is connected to each end-tap 6 and 8 of the high-voltage winding. Choke input filter is used which will deliver a more constant output voltage with a varying load than a capacitor input filter. There will be less stress on the rectifier tubes with choke input filter. Two identical filter chokes (94-1, 94-2) are used, the high-voltage filter choke is in series with the tap of the filament transformer which supplies the two parallel tube filaments and the high-voltage direct-current output to the isolantite bushing terminal 17. The second or low-voltage filter choke (94-2) is in series with the center-tap (7) of the high-voltage winding and terminal 16 on the bakelite terminal board. Each of these chokes is shielded and rated 11 henries 270 ma d-c and 90 ohms d-c resistance. One high-voltage filter capacitor (91) rated 10-mfd, 1,500 direct-current working volts, foil-paper and oil-filled case is connected across the load side of the lower-voltage choke to ground.

Three bleeder resistors are used. One low-voltage bleeder (95-1) is used strictly as a bleeder. It is connected from ground to the next low-voltage bleeder (96). This bleeder (95-1) is rated 8,000 ohms at 90 watts. The other low-voltage bleeder (96) is rated 1,500 ohms at 40 watts and connected from the low-voltage choke output and terminal 16 on the terminal board to the lowest-voltage bleeder (95-1). The mid-tap of these two resistors are connected to terminal 15 on the terminal board. This bleeder resistor (96) is also used as a voltage-dropping resistor. The high-voltage bleeder resistor (95-2) is connected across the direct current output of the two filter-chokes. This resistor is rated 8,000 ohms at 90 watts. These resistors may be replaced easily because they are connected and held in position by fuse clips, similar to cartridge fuse clips. Holes are punched in the top of the chassis to allow heat, dissipated by the bleeder resistors, to escape more freely.

27. POWER CONTROL PANEL PN-13-A CHARACTERISTICS.

The power-control panel is the bottom panel of Cabinet CS-88-A. It controls the line input to the proper load supply voltage. There are two pairs of line input terminals. One pair of terminals 1 and 2 are used when the line input is between 110 and 125 volts a-c, 50 to 60 cycles single-phase. The other pair of terminals 3 and 4 are used when the line input is between 220 and 250 volts a-c, 50 to 60 cycles single-phase. Each of the two pairs of lines is fused with Fusetron slow-blow cartridge fuses. The ratings of these fuses are such that they will take an overload of a certain amount for a short time, that is when the transmitter is switched ON. However, they will blow almost instantaneously if subject to a short circuit. The position of these fuses and their ratings is plainly marked on the natural bakelite terminal board. They may be easily replaced by inserting them into the fuse clips. The 110/125-volt line-input fuses (111-1, 111-2) are rated 250 volts at 10 amperes and the 220-250-volt line-input fuses (112-1, 112-2) are rated 250 volts at 5 amperes. One line of each pair is a common line on the load side of the fuses. This line is not made common on the line input terminals due to the difference in rating of the fuses.

The **POWER MAINS ON-OFF** switch, (116) is a 3-pole, single-throw switch rated 250 volts at 15 amperes. This switch controls the **ON-OFF** supply power to the entire transmitter regardless of which pair of line input terminals are used. When the 110/125-volt line input is used, connections are made to an autotransformer which is bolted to the bottom of the cabinet. There are three terminals of the autotransformer of which 9 is common, 7 the high side, and 8 the 110/125-volt tap. The alternating-current voltage across the terminals 7 and 9 will be two times the voltage across terminals 8 and 9. When 110/125 volts are applied to terminals 8 and 9 the autotransformer steps up the voltage to 220/250 volts. The primaries of all transformers on the various panels operate with an input voltage of 230 volts.

The autotransformer is designed to operate continuously to 60 cycles from 110/125-volt source to 220/250-volts at 1,000 volt-ampere output. The line variac (117) is designed for continuous operation from a line of 220 to 250 volts, 50 to 60 cycles and to supply 230 volts, 1,100 volt-amperes to load, terminals 5 and 6. *Before turning on the transmitter, if in doubt that the control is at the proper setting, turn the control wheel counterclockwise to STOP.* Then throw the **POWER MAINS ON-OFF** switch (116) **ON** and turn the variac control wheel clockwise until the output voltmeter (113) indicates 230 volts (red line). With the control wheel in the extreme counterclockwise position and 230 volts applied to the variac and no voltage output, it consumes approximately 15 watts. The rotor of the variac should not be brought sharply against the stop with considerable force because the brushes may be broken.

The alternating-current output voltmeter (113) is connected permanently to the output load terminals 5 and 6. The scale on the meter is 0 to 300 volts a-c with a red line on the scale at 230 volts which is the correct load voltage. The meter is mounted on a 1/32-inch steel cup-line panel that is recessed from the main panel and at an angle so that it may be easily read without stooping. A cup shield which fits around the meter prevents any stray induced field from the variac causing false readings. The two vertical 3/8-inch metal strips in front of the meter act as a guard.

A clear pilot lamp (114) rated 6 watts at 150 volts with candelabra base is mounted on the front panel directly above the main line switch in a bull's-eye unit (115) with a red insert. The pilot lamp may be removed from the front of the panel by first removing the glass jewel.

28. FUNCTION OF OPERATING CIRCUITS.

Since the transmitter is a closely coordinated unit, the operating circuits involve several panels. A clear understanding of their functioning can be had by studying figure 20.

The **POWER MAINS** switch controls all power to the transmitter. Power admitted by this switch is applied to the autotransformer.

NOTE

> The autotransformer remains connected across the line at all times. A 110-volt power source is applied to one half of the autotransformer; by connecting the load to the end terminals, the output voltage is made double the input voltage. The variac transformer 117 is also connected across the line, but in such a manner that it can either increase or decrease the voltage output to the load to compensate for supply line changes. The variac output is completely controlled by the **MASTER FILAMENTS** switch. When this switch is open, no power can pass to any of the operating circuits of the transmitter. When this switch is closed, power is available to the **A.F.** and **R.F. FILAMENT** switches controlling the filament transformers, to the primary of the low-voltage transformer, and to the **MASTER H.V.** switch. Before plate voltage can be applied to the transmitter, the **MASTER H.V.** and the door interlock switch *must be closed*. Also, the plate control relay (8) must be energized. This relay is energized by the 24-volt output of the L.V. rectifier when the **LOCAL-REMOTE** switch is set at **LOCAL**, or when a microphone is connected across the remote microphone line (with the **LOCAL-REMOTE** switch set at **REMOTE**). Thus the comparatively small

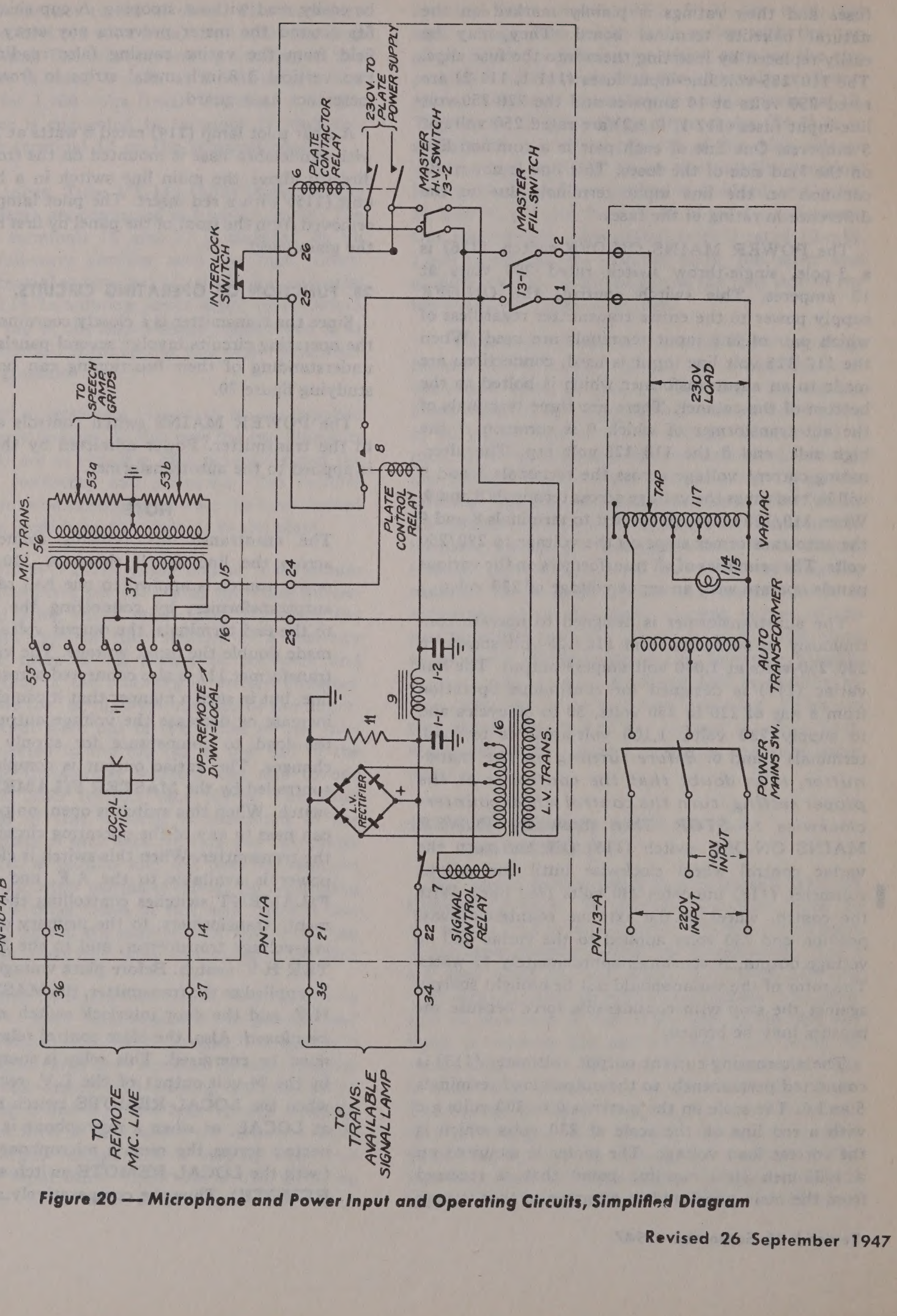

TO REMOTE MIC. LINE
TO TRANS. AVAILABLE SIGNAL LAMP
36
37
35
34
PN-10-A,B
13
14
PN-11-A
21
22
SIGNAL CONTROL RELAY
7
PN-13-A
220V INPUT
110V INPUT
LOCAL MIC.
UP=REMOTE
DOWN=LOCAL
55
L.V. RECTIFIER
11
1-1
9
1-2
16
L.V. TRANS.
POWER MAINS SW.
AUTO TRANSFORMER
16
23
15
24
37
MIC. TRANS.
56
53a
53b
TO SPEECH AMP GRIDS
8
PLATE CONTROL RELAY
114
115
117
TAP
VARIAC
230V LOAD
25
26
INTERLOCK SWITCH
9
PLATE CONTACTOR RELAY
230V. TO PLATE POWER SUPPLY
MASTER H.V. SWITCH 13-2
MASTER FIL. SWITCH
13-1
1
2

Figure 20 — Microphone and Power Input and Operating Circuits, Simplified Diagram

microphone current energizes the plate control relay; this closes and applies 230 volts a-c to plate contactor relay 6. Relay 6 is large enough to control the heavy plate current to the transmitter. When the LOCAL-REMOTE switch is set at REMOTE, and the microphone is removed from the circuit, these two relays open and the carrier is cut off the air. A press-to-talk microphone can be used in either the local or remote operating positions if available. If one is used, plate current will be applied to the transmitter only when the microphone circuit is closed (switch is pressed).

The output of the L.V. transformer is rectified by the full-wave selenium rectifier; the rectifier output is filtered by a standard condenser-input filter, and supplies 24 volts d-c to the coil of the signal-control relay, to a local microphone, to a remote microphone line, and to terminals 34 and 35 on the cabinet terminal board, depending on the position of the LOCAL-REMOTE switch (55).

When set at REMOTE, this switch connects the remote microphone to the primary of microphone transformer 56; it disconnects the local microphone from the microphone transformer primary, and it grounds the coil of the signal control relay (7), short-circuiting the coil and allowing the relay to return to the inoperative (*closed*) position. This permits the rectifier output of 24 volts d-c to light a lamp at the remote operating position, indicating that the transmitter is turned on and available for modulation from the remote operating point.

When set at LOCAL, this switch disconnects the remote microphone line from the microphone transformer primary; it connects the local microphone to the microphone transformer primary, and removes the ground from the coil of signal control relay 7. This energizes the coil, opening the relay contacts and extinguishing the signal lamp at the remote operating point.

NOTE

The local microphone is connected to taps on the microphone transformer's split primary, for impedance matching.

29 OPERATING CONTROLS OF RADIO TRANSMITTER BC-640-A.

a. POWER CONTROL PANEL PN-13-A.

(1) POWER MAINS switch.—This is the main power switch (116) and controls all power to the transmitter.

(2) VOLTAGE INCREASE wheel.—This controls the tap on the variable ratio transformer (117), and compensates for various input voltages.

(3) OUTPUT VOLTAGE meter (113).—This measures the voltage supplied to all other panels in the transmitter.

b. CONTROL PANEL PN-11-A.

(1) TUNE-OPERATE switch (14).—When set at TUNE, this switch halves the voltage supplied the plates of tubes on Oscillator Panel PN-9-A and Amplifier Panel PN-8-A. When set at OPERATE, full plate voltage is supplied to these panels.

(2) R.F. FILAMENTS switch (15-1) and indicator lamp above it.—The switch controls and the lamp indicates filament power supply to Oscillator Panel PN-9-A, Amplifier Panel PN-8-A, and lower Power Supply Panel PN-12-A.

(3) A.F. FILAMENTS switch (15-2) and indicator lamp above it.—The switch controls and the lamp indicates filament power supply to Modulator Panel PN-10-A and upper Power Supply Panel PN-12-A.

(4) R.F.H.V. switch (15-3) and indicator lamp above it.—The switch controls and the lamp indicates plate power supply to Oscillator Panel PN-9-A and Amplifier Panel PN-8-A.

(5) A.F.H.V. switch (15-4) and indicator lamp above it.—The switch controls and the lamp indicates plate power supply to Modulator Panel PN-10-A.

(6) MASTER FILAMENTS switch (13-1).—This switch controls power supplied to the entire transmitter except Power Control Panel PN-13-A. It is effectively in the output circuit of the variable ratio transformer (117).

(7) MASTER H.V. switch (13-2).—This switch controls plate power supply to Modulator Panel PN-10-A, Oscillator Panel PN-9-A, and Amplifier Panel PN-8-A, and prepares the circuit for the plate contactor relay (6).

c. MODULATOR PANEL PN-10-A.

(1) The LOCAL-REMOTE switch (55) connects either the remote microphone line or the local MICROPHONE jacks (on the front of this panel) to the primary of the microphone transformer. Other functions of this switch are discussed in paragraph 24.

(2) The slotted VOLUME CONTROL (53*a* and 53*b*) controls the input to the grids of the first speech amplifier.

(3) The MODULATOR ANODE CURRENT milliammeter (44) shows the plate and *grid current* of the class B modulator, and thus gives a comparative indication of the modulation level.

(4) A slotted volume control (52*a* and 52*b*), on the top of the chassis at the rear, controls output of the audio oscillator.

(5) The MICROPHONE jacks (40, 41) are for connection of a microphone when the station is to be locally operated.

d. OSCILLATOR PANEL PN-9-A.

(1) The CO/T1 dial controls two ganged variable capacitors (163-1 and 163-2) which tune the plate circuits of the oscillator and first tripler.

(2) The small T1 knob above the CO/T1 dial controls a small trimmer capacitor (167) for precise adjustment of the first tripler plate tank circuit.

(3) The T2 dial controls the plate tuning capacitor (170) of the second tripler.

(4) The D dial controls capacitor 171, which tunes the plate of the doubler and the grid of the IPA stage.

(5) The IPA dial controls variable capacitor 172, which tunes the plate circuit of the IPA stage.

(6) The NEUT. knob controls capacitor 173, the IPA neutralizing capacitor.

(7) The IPA GRID CURRENT METER (186) measures current in the IPA grid circuit.

(8) The CATHODE CURRENT meter (187) is used to measure the cathode current of all the tubes on the oscillator panel, one at a time.

(9) The CO-T1-T2-D-IPA switch (176) places the CATHODE CURRENT meter in the proper circuit to measure the cathode current of any tube on this panel, as required.

(10) The neutralizing link (at the rear of the chassis) removes plate voltage from the IPA stage when it is removed.

e. AMPLIFIER PANEL PN-8-A.

(1) The AERIAL dial controls capacitor 130, which tunes the antenna coupling circuit.

(2) The COUPLING dial controls coupling between the final amplifier plate inductance and the antenna inductance.

(3) The ANODE dial controls capacitor 129, which tunes the plate circuit of the final amplifier.

(4) The AMP. GRID dial controls capacitor 128, which tunes the grid circuit of the final amplifier.

(5) The NEUT. dial controls two ganged capacitors (131*a* and 131*b*) which neutralize the final amplifier.

(6) The CATHODE CURRENT meter (140) indicates cathode current of either of the tubes in the final amplifier.

(7) The C1-C2 switch (150) selects the tube whose cathode current is to be measured by the CATHODE CURRENT meter. Tube 1 is the tube toward the rear of the chassis and tube 2 is the front tube.

(8) The GRID CURRENT meter (139) indicates grid current of either of the tubes in the final amplifier, or the diode current of the monitor rectifier.

(9) The G1-G2-MON. switch (149) selects the tube in the final amplifier whose grid current is to be measured by the GRID CURRENT meter or the diode monitor whose current draw is to be measured by the same meter.

(10) The MONITOR TEL. jack (133) permits plugging in headphones on this panel to monitor modulated output of the transmitter.

(11) The neutralizing link (rear of chassis) cuts off the high-voltage supply to the final amplifier plates when it is removed.

(12) The plate line shorting bar (top of chassis) adjusts the plate inductance of the final amplifier.

(13) The grid line shorting bar (under chassis) adjusts the grid inductance of the final amplifier.

(14) The adjustable tap on the antenna tuning circuit couples the antenna tuning circuit to the concentric antenna cable at a point where the impedance of the antenna tuning circuit matches the characteristic impedance of the antenna cable.

(15) The antenna circuit shorting bar adjusts the inductance of the antenna tuning circuit.

f. RADIO TRANSMITTER BC-640-B.

(1) POWER CONTROL PANEL PN-13-B.

(*a*) POWER MAINS switch.—This is the main power switch (116) and controls all power to the transmitter.

(2) VOLTAGE INCREASE wheel.—This moves the tap on the variable ratio transformer (117) and compensates for various input voltages.

(3) OUTPUT VOLTAGE meter (113).—This measures voltage supplied to all other panels in the transmitter.

g. CONTROL PANEL PN-11-A.

(1) TUNE-OPERATE switch (14).—When set at TUNE, this halves plate voltage supplied to Oscillator Panel PN-9-B and Amplifier Panel PN-8-B. When set at OPERATE, full plate voltage is supplied to these panels.

(2) R.F. FILAMENTS switch (15-1) and indicator lamp above it.—The switch controls and the lamp shows filament power supply to Oscillator Panel PN-9-B, Amplifier Panel PN-8-B and lower Power Supply Panel PN-12-A.

(3) A.F. FILAMENTS switch (15-2) and indicator lamp above it.—The switch controls and the lamp shows filament power supply to Modulator Panel PN-10-B and upper Power Supply Panel PN-12-A.

(4) R.F.H.V. switch (15-3) and indicator lamp above it.—This switch controls and the lamp shows plate power supply to Oscillator Panel PN-9-B and Amplifier Panel PN-8-B.

(5) A.F.H.V. switch (15-4) and indicator lamp above it.—This switch controls and the lamp shows plate power supply to Modulator Panel PN-10-B.

(6) MASTER FILAMENTS switch.—This switch (13-1) controls power supplied to the entire transmitter except Power Control Panel PN-13-B. It is effectively used in the output circuit of the variable ratio transformer (117).

(7) MASTER H.V. switch.—This switch (13-2) controls plate power supply to Modulator Panel PN-10-B, Oscillator Panel PN-9-B, and Amplifier Panel PN-8-B and prepares the circuit for the plate contactor relay (6).

(8) MODULATOR PANEL PN-10-B.

(*a*) The LOCAL-REMOTE switch (55) connects either the remote microphone line or the local MICROPHONE jacks (on the front of this panel) to the primary of the microphone transformer. Other functions of this switch are discussed in paragraph 28.

(*b*) The slotted VOLUME CONTROL (53*a* and 53*b*) controls the input to the grids of first speech amplifier.

(*c*) A slotted volume control (52*a* and 52*b*) on the top of the chassis at the rear controls output of the audio oscillator.

(*d*) The MICROPHONE jacks (40 and 41) are for connection of a microphone when the stations are to be locally operated.

(9) OSCILLATOR PANEL PN-9-B.

(*a*) The CO/T1 dial controls two ganged variable capacitors (163-1 and 163-2) which tune the plate circuits of the oscillator and first tripler.

(*b*) The small T1 knob above the CO/T1 dial controls a small trimmer capacitor (167) for precise adjustment of the first tripler plate tank circuit.

(*c*) The T2 dial controls the plate tuning capacitor (170) of the second tripler.

(*d*) The D dial controls capacitor 171, which tunes the plate of the doubler and the grid of the IPA stage.

(*e*) The IPA dial controls variable capacitor 172, which tunes the plate circuit of the IPA stage.

(*f*) The NEUT. knob controls capacitor 173, the IPA neutralizing capacitor.

(*g*) The CO-T1-T2-D-IPA switch (176) refers the cathode circuit of any tube on this panel to the METER RANGE-MILLIAMPERES switch and meter on Amplifier Panel PN-8-B for measurement, as required.

(*h*) The neutralizing link (at the rear of the chassis) removes plate voltage from the IPA stage.

(10) AMPLIFIER PANEL PN-8-B.

(*a*) The AERIAL dial controls capacitor 130, which tunes the antenna coupling circuit.

(*b*) The COUPLING dial controls coupling between the final amplifier plate inductance and the antenna inductance.

(*c*) The ANODE dial controls capacitor 129, which tunes the plate circuit of the final amplifier.

(*d*) The NEUT. dial controls two ganged capacitors (131*a* and 131*b*) which neutralize the final amplifier.

(*e*) The C1-C2 switch (150) selects the amplifier tube whose cathode circuit is to be referred to the METER RANGE-MILLIAMPERES switch (154) and meter (139) for measurement. (Tube 1 is the tube towards the rear of the chassis and Tube 2 is the tube nearest the panel.)

(*f*) The G1-G2-MON. switch (149) selects the tube whose grid current is to be referred to the METER RANGE-MILLIAMPERES switch and meter for measurement. Tube 1 is the rear tube and Tube 2 is the front tube.

(*g*) The METER RANGE-MILLIAMPERES switch (154) and M.A. CURRENT meter measure current in all important circuits of the modulator, oscillator and amplifier panels.

(11) CURRENT MEASUREMENTS ON RADIO TRANSMITTER BC-640-B.

To Measure	*Of*	*Set Meter Range Milliamperes switch At*	*Setting of other Switches*	*Multiply Meter Reading By*
Anode current	modulator	MOD		8
Cathode current	oscillator	EXC-C	CO-T1-T2-D-IPA at CO	4
Cathode current	1st tripler	EXC-C	CO-T1-T2-D-IPA at T1	4
Cathode current	2nd tripler	EXC-C	CO-T1-T2-D-IPA at T2	4
Cathode current	doubler	EXC-C	CO-T1-T2-D-IPA at D	4
Cathode current	IPA	EXC-C	CO-T1-T2-D-IPA at IPA	4
Grid current	IPA	IPA-G		1
Cathode current	Final amplifier (front tube)	PA-C	C1-C2 at C2	4
Cathode current	Final amplifier (rear tube)	PA-C	C1-C2 at C1	4
Grid current	Final amplifier (front tube)	PA-G	G1-G2-MON. at G2	1
Grid current	Final amplifier (rear tube)	PA-G	G1-G2-MON. at G1	1
Diode current	monitor	PA-G	G1-G2-MON. at MON.	1

(12) The MONITOR TEL. jack (133) permits plugging in headphones on this panel to monitor modulated output of the transmitter.

(13) The neutralizing link (rear of chassis) cuts off the high-voltage supply to the final amplifier plates when it is removed.

(14) The plate line shorting bar (top of chassis) adjusts the plate inductance of the final amplifier.

(15) The grid line shorting bar (under chassis) adjusts the grid inductance of the final amplifier.

(16) The flexible antenna coupling strip couples the antenna tuning circuit to the concentric antenna cable at a point where the impedance of the antenna tuning circuit matches characteristic impedance of the antenna cable.

(17) The antenna circuit shorting bar adjusts the inductance of the antenna tuning.

30. CABINET CS-88-A CHARACTERISTICS.

This cabinet houses all of the components of the transmitter. The following is a list of panels from top to bottom consecutively: Amplifier PN-8-A, Amplifier PN-8-B, Oscillator PN-9-A, Oscillator PN-9-B, Modulator PN-10-A, Modulator PN-10-B, Control PN-11-A, two Power Supplies PN-12-A, and

Power Control PN-13-A, and Power Control PN-13-B.

Handles are provided on the front of each panel and extend 1¾ inches from the panel. They are useful when removing the panels from the cabinet. When servicing the equipment the panels may be turned face down and rested on the handles.

A single door on three pin hinges in the rear gives access to the rear of all panels. The door is cut off at the bottom about 7 inches from the base of the cabinet and a separate panel is screwed to the frame and may be removed separately. The reason for this is that when the transmitter is installed in Truck K-53 the door clears the wheel housing of the truck. In order to service Power Control Panel PN-13-A, (change fuses, to connect the remote microphone and control lines, and the power line input), it may be necessary to get to the rear of the PN-13-A panel, so a separate removable panel is used. This bottom panel is held in place with four screws.

A 2½ inch hole in the upper right-hand corner of the rear of the cabinet is faced with two pieces of bakelite through which the coaxial transmission line is run. There is a rubber grommet inside of the split bakelite board. There is one hole approximately 1⅛ inches at the bottom rear of each side. Rubber grommets are placed in the holes for protection to the cables. These holes are used to pass through the input power lines and remote cables.

All of the interpanel wiring is cabled and tied securely in place. All of the tubes on the panels may be changed from the rear. An interlock, single-pole, normally-open, momentary-contact switch rated 250 volts at 3 amperes is mounted to the center of the stationary part of the cabinet near the door latch. The contacts of the interlock are in series with the high-voltage plate contactor (6), contacts on the plate control relay (8), and the line on Control Panel PN-11-A. With the interlock open, it does not allow the primary voltage to be applied to the high-voltage transformers; however, all of the tube filaments signal and microphone circuits are still ON.

There are four holes for ⅜-inch bolts in the gusset plates at the bottom of the cabinet so that the cabinet may be bolted to the floor (see figure 4). A bakelite terminal board is mounted on two metal brackets which are supported by two bolts on each bracket and mounted to the bottom angle iron. There are ten terminals on this board, six terminals used for the phone input, signal and monitor remote lines and two for 110/125-volt and two for 220/250-volt power input. In order to gain access to this terminal board remove the solid panel below the door which is secured to the cabinet with four screws.

SECTION V
MAINTENANCE

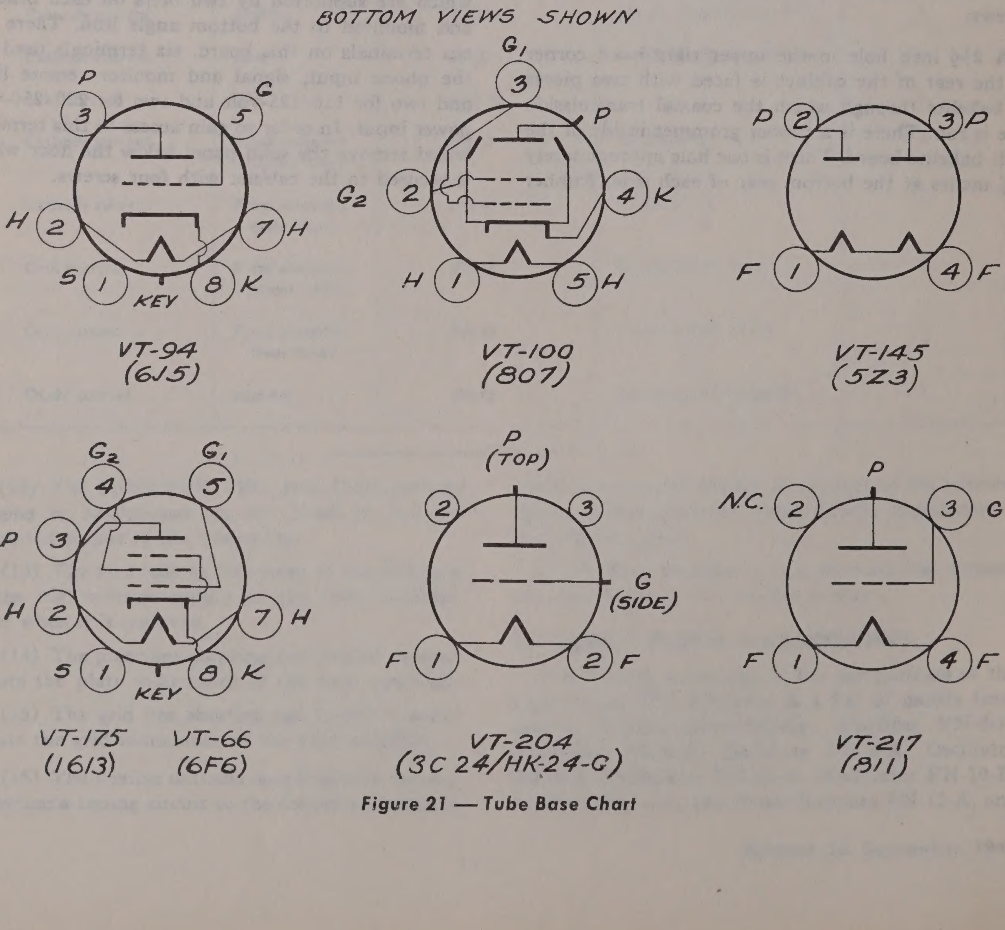
31. GENERAL.

Before removing a panel from Radio Transmitter BC-640-A, find out the cause of failure and isolate the particular faulty component or circuit of the equipment. *LOOK FOR THE SIMPLE CAUSES OF TROUBLE FIRST.*

Many defects can and may develop in a complex piece of radio equipment. Remember that time can always be saved by analyzing the *cause* of trouble and *localizing* it to a particular sub-assembly or component.

Study the complete schematic circuit diagram and go over in your mind the various *possible* causes of failure. Remember that fuses, vacuum tubes and pilot lamps are the most likely items to go bad. Filter and bypass capacitor are the next most common source of trouble. Usually when a capacitor breaks down, the voltage on one side of the capacitor is shorted directly to ground. Small resistors are a frequent source of trouble too. They may change value, short or open. When you have found which is the defective unit, remove and repair it or replace it with a good unit.

A suitable dummy antenna for testing Radio Transmitter BC-640-A, or BC-640-B is a 75-watt, 250-volt lamp connected between ground and the center electrode of the antenna terminal.



VT-94 (6J5)

VT-100 (807)

VT-145 (5Z3)

VT-175 (1613) VT-66 (6F6)

VT-204 (3C 24/HK-24-G)

VT-217 (811)

Figure 21 — Tube Base Chart

CAUTION

Before removing Amplifier Panel PN-8-A, set coupling dial at 100 to lower the antenna coupling loop and prevent its being bent or broken.

32. ROUTINE INSPECTION AND OVERHAUL.

a. Inspect all nuts, bolts, and screws for tightness.

b. Remove loose solder, dirt, and metallic chips.

c. Clean equipment thoroughly. Remove all traces of corrosion.

d. Inspect wiring and soldered joints. If necessary, clean plug connectors.

e. Do not disturb coils or alignment adjustments while making inspection.

f. Check tubes, using Supreme Tube Tester Model 504-A or equal where applicable. Replace defective tubes.

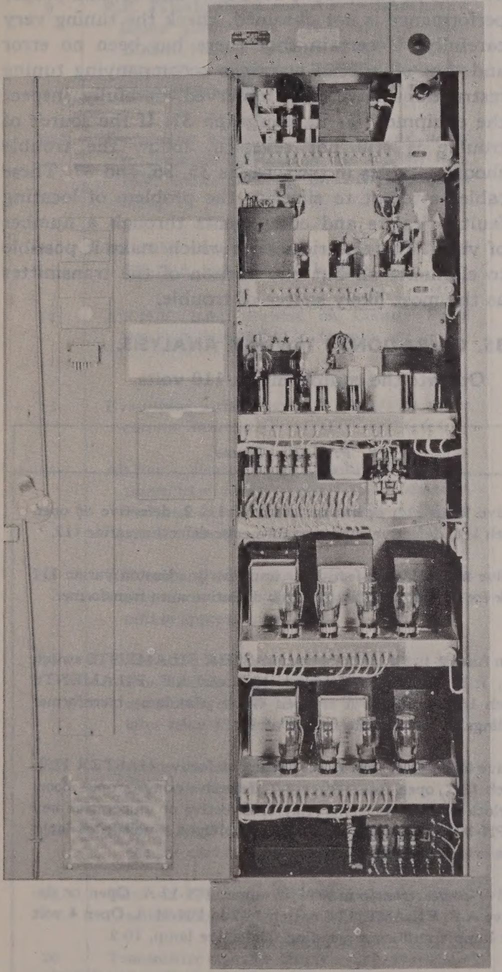


Figure 22 — Radio Transmitter BC-640-A, Rear View with Door Open

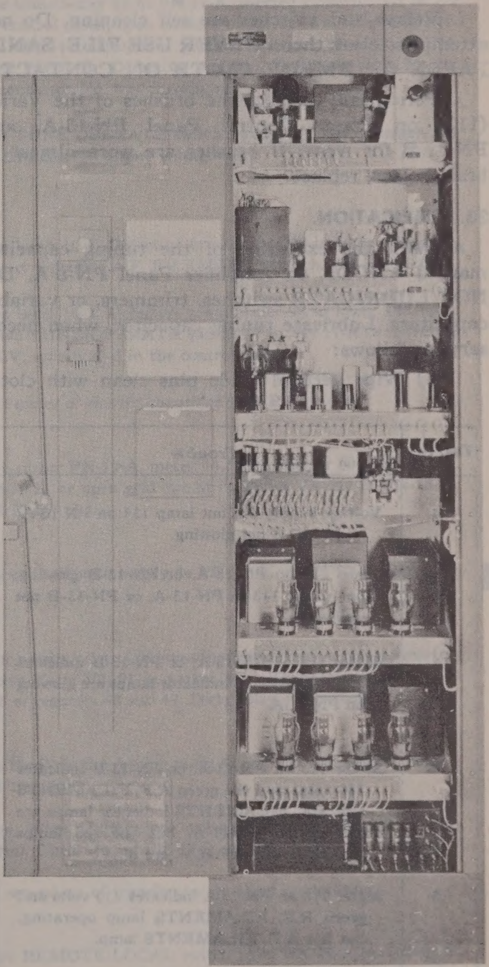


Figure 23 — Radio Transmitter BC-640-B, Rear View with Door Open

g. Check tuning capacitors for dirt or bent plates. *Do not lubricate* before consulting paragraph 33. If an air hose is used to blow dust and dirt from the cabinet, *make certain that the compressed air supply is free from water and that the pressure is not great enough to bend the capacitor plates.*

h. Inspect contactor 6 on Control Panel PN-11-A. If the contactor emits a buzzing sound, drop the line voltage to about 90 volts. The contactor is operating satisfactorily if it drops out at approximately 90 volts.

i. Relays and switches are self cleaning. Do not attempt to clean them. NEVER USE FILE, SANDPAPER OR EMERY CLOTH ON CONTACTS.

j. Periodically inspect the brushes of the Variac (117) on Power Control Panel PN-13-A, and PN-13-B for wear. If brushes are worn almost to brass holder, replace.

33. LUBRICATION.

a. With the exception of the tuning capacitor marked ANODE on Amplifier Panel PN-8-A, DO NOT LUBRICATE switches, trimmers, or variable capacitors. Lubricate tuning capacitor, when necessary, as follows:

(1) Wipe vertical guide pins clean with cloth.

(2) Grease with vaseline and wipe clean again with cloth.

b. All other movable parts are sufficiently lubricated for the lifetime of the equipment. However, if careful inspection reveals lubrication is necessary, use AXS-637 grease or equal very sparingly. DO NOT ALLOW grease to get on any tuned circuit component of the transmitter.

34. TROUBLE LOCATION AND REMEDY.

If the transmitter has been properly tuned up as directed in paragraphs 15, 16, 17 and 18, and proper performance is not obtained, check the tuning very carefully. If certain that there has been no error and that all special warnings accompanying tuning instructions have been observed, carefully inspect the equipment as in paragraph 31. If the source of trouble is still not revealed, follow the trouble shooting tables in paragraphs 35, 36, and 37. These tables attempt to simplify the problem of locating faulty circuits and components through a number of visual and electrical tests which make it possible to eliminate all but one portion of the transmitter as the most likely source of trouble.

35. OPERATIONAL TROUBLE ANALYSIS.

Operate the equipment on 110 volts.

Test No.	*Trouble*	*Probable Cause*
1	Voltage supply on, but lamp 114 on PN-13-A, or PN-13-B not glowing.	Defective lamp 114, open fuse 111-1 or 111-2, defective or open switch 116, defective auto-transformer or defective variac 117.
2	Lamp 114 on PN-13-A, or PN-13-B glowing, but meter 113 in PN-13-A, or PN-13-B not indicating.	Defective meter 113, defective or improperly adjusted variac 117 (look for defective sliding brush), defective auto-transformer.
3	Meter 113 on PN-13-A, or PN-13-B indicates 230 volts, but no indicator lamps are glowing on PN-11-A.	Open fuses 2-1, 2-2, or defective MASTER FILAMENTS switch 13-1, R.F. FILAMENT switch 15-1 and A.F. FILAMENTS switch 15-2 in PN-11-A or open 4-volt pilot lamp transformer windings. Defective interpanel wiring.
4	Meter 113 on PN-13-A, or PN-13-B indicates 230 volts, and the green R.F. FILAMENTS and A.F. FILAMENTS indicator lamps are glowing on PN-11-A, but the red lamps R.F H.V. and A.F.H.V. are off.	Defective lamps 10-3 and 10-4. Open or defective MASTER H.V. switch 13-2, open fuse 3-1, or 3-2, defective relay 6, open door-interlock switch, defective relay 8, defective or inoperative key on PN-11-A. Key not set at LOCAL. Open 4-volt pilot lamp transformer windings.
5	Meter 113 on PN-13-A indicates 230 volts and green R.F. FILAMENTS lamp operating, but not A.F. FILAMENTS lamp.	Defective power transformer 97 in upper PN-12-A. Open or defective A.F. FILAMENTS switch 15-2 in PN-11-A. Open 4-volt pilot lamp transformer winding. Defective lamp, 10-2.
6	Meter 113 on PN-13-A, or PN-13-B indicates 230 volts and A.F. FILAMENTS lamp is on, but R.F. FILAMENTS lamp is off.	Defective transformer 97 in lower PN-12-A, open or defective R.F. FILAMENTS switch 15-1 in PN-11-A. Defective lamp, 10-1.

Test No.	*Trouble*	*Probable Cause*
7	Red R.F.H.V. and A.F.H.V. indicator lamps glowing on PN-11-A but green R.F. FILAMENTS and A.F. FILAMENTS lamps not glowing.	Open fuses 4-1 and 4-2. Defective lamps. Defective transformer wiring. Shorted terminals.
8	Transmitter operates properly, but no response obtained on TRANSMITTER AVAILABLE signal lamp at remote operating position	Defective lamp. Defective wiring between remote operating point and transmitter. Defective relay 7 in PN-11-A. Defective rectifier transformer, rectifier or capacitors 1-1, 1-2, 1-3, 1-4.
9	R.F. FILAMENTS and A.F. FILAMENTS lamps glowing on PN-11-A, but when LOCAL-REMOTE switch 55 in PN-10-A, or PN-10-B is switched to LOCAL, no clicking of relays is heard.	Defective transformer 16 in PN-11-A, shorted capacitor 1-1 or 1-2 in the control panel, open choke 9 or defective switch 55 in PN-10-A. Defective microphone plugged into jack 40 or 41 on PN-10-A, or PN-10-B. Defective rectifier. Defective relay No. 8, H.V. contactor No. 6 or interlock.
10	Transmitter output is very weak, all meter readings are half-scale or less and the R.F. H.V. indicator lamp on PN-11-A glows dimly.	Defective TUNE-OPERATE switch 14 on PN-11-A or switch not set at OPERATE. Input voltage low.
11	R.F.H.V. lamp glowing on Control Panel PN-11-A, but A.F.H.V. lamp is not.	Defective lamp 10-4. Defective transformer 98 in upper PN-12-A or open or defective A.F. FILAMENTS switch 15-4 in PN-11-A.
12	A.F.H.V. lamp glowing on Control Panel PN-11-A, but R.F.H.V. lamp is not.	Defective lamp 10-3. Defective transformer 98 in lower PN-12-A. defective TUNE-OPERATE switch 14 in PN-11-A or defective R.F.H.V. switch 15-3 in the control panel.
13	Everything satisfactory, but modulator anode current incorrect.	Defective meter or shorted capacitor 39 in PN-10-A*.
14	All four indicator lamps glowing on PN-11-A, transmitter carrier output is satisfactory, but there is no modulation and no modulator anode current.	Defective upper PN-12-A, meter 44,* transformer 60 in PN-10-A, or PN-10-B, or open grid circuit in Tubes VT-217 in PN-10-A, or PN-10-B.
15	R.F. output satisfactory, but no modulation present on carrier and modulator anode current is approximately 8 ma.	No high voltage plate supply to PN-10-A, or PN-10-B. Defective tubes.
16	Transmitter operates properly but there is no tone modulation when terminals 11 and 12 are shorted on PN-10-A, or PN-10-B. Modulator relay 42 closes (hear it click).	Oscillator output control 52 misadjusted, defective transformer 61, defective Tube VT-94 in socket 62-5. Defective capacitors 34 and 35 or resistors 48 and 49. Dirty relay 42 contacts.
17	Same as 16, but relay 42 does not close when terminals 11 and 12 are shorted.	Same as 16. Defective keying relay 42, rectifier 54, shorted capacitor 36-1 or 36-2.
18	Same as 15. Modulator anode current low and the per cent of modulation is very low.	Defective tubes. Low plate voltage. Volume control 53 misadjusted. Check entire PN-10-A, or PN-10-B.
19	Same as 14 except modulator anode current satisfactory.	Shorted secondary of transformer 59 when modulating.
20	Transmitter operates properly on tone modulation but not on speech modulation.	Defective REMOTE-LOCAL switch 55 in PN-10-A, or PN-10-B, open resistor 45-1 or 45-2, defective transformer 56, defective microphone or defective jacks 40, 41.

*On Radio Transmitter BC-640-A only.

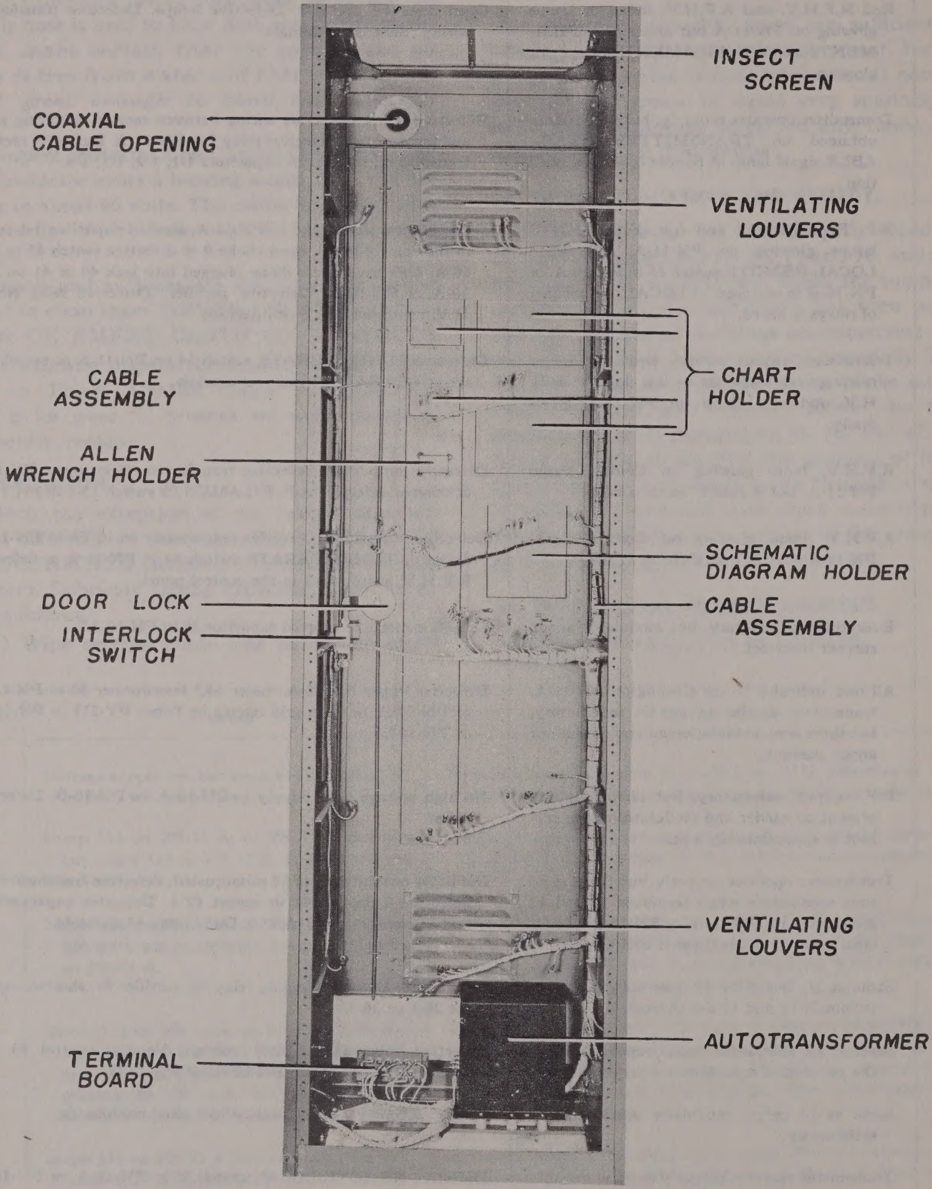

INSECT SCREEN
COAXIAL CABLE OPENING
VENTILATING LOUVERS
CHART HOLDER
CABLE ASSEMBLY
ALLEN WRENCH HOLDER
SCHEMATIC DIAGRAM HOLDER
DOOR LOCK
CABLE ASSEMBLY
INTERLOCK SWITCH
VENTILATING LOUVERS
AUTOTRANSFORMER
TERMINAL BOARD

Figure 24 — Radio Transmitter BC-640-A, and BC-640-B, Front View, Panels Removed

Test No.	*Trouble*	*Probable Cause*
21	No current indications for PN-9-A, or PN-9-B, with meter switch 176 in any one of its five positions. All four indicator lamps on PN-11-A are glowing.	Defective filament transformer 196 on PN-9-A, or PN-9-B, or defective lower PN-12-A. Defective meter. Defective rotor contact of switch 176.
22	All circuits satisfactorily tuned on PN-9-A, or PN-9-B, except IPA plate circuit which gives no indication of resonance.	Open resistor 195, defective Tube VT-204 in socket 199-3, open choke 177 or 159, neutralizing link not in place, defective 800-volt circuit in lower PN-12-A. Defective meter switch 176.
23	No dip obtained in oscillator cathode current with meter switch 176 in CO position. Meter indicates correct off-tune current (about 30 ma).	No crystal in socket, or defective crystal. Defective Tube VT-175 or VT-66. Shorted tank circuit. Defective Tube VT-100.
24	No cathode current indicated for oscillator or first tripler with meter switch 176 set at CO or T1.	Defective 315-volt circuit in lower PN-12-A or defective wiring between terminal 13 on PN-9-A, or PN-9-B and terminal 15 on lower PN-12-A. Defective meter switch.
25	2nd tripler cathode current below 35 ma. Plate circuit cannot be tuned.	Defective Tube VT-100 or Tube VT-204 in socket 199-1. Defective capacitor 168-1.
26	Meter indicates proper cathode current for PN-9-A, or PN-9-B with meter switch 176 in any position except T2.	Open resistor 192-2.
27	Meter indicates proper cathode current for PN-9-A, or PN-9-B, with meter switch 176 in CO or IPA position but not with switch at T1, T2 or D.	Defective 395-volt circuit in lower PN-12-A. Defective wiring between terminal 14 on PN-9-A, or PN-9-B and terminal 16 on lower PN-12-A.
28	IPA grid current 7 ma or less.	One or more defective tubes in PN-9-A, or PN-9-B, or IPA improperly neutralized.
29	No cathode current indicated for PN-8-A, or PN-8-B with meter switch 150 in position C1 or C2.	Upper neutralizing link not in place, open choke 134-1, defective transformer 146, open secondary of transformer 59 of PN-10-A, or PN-10-B. Plate bypass capacitor 125 shorted. No plate supply voltage.
30	Cathode current for PN-8-A, or PN-8-B indicated at only one position of meter switch 150.	Defective resistor 143-1 or 143-2, defective meter switch 150. Defective Tube VT-204. No filament power. Plate shorting bar improperly tightened.
31	Cathode currents of final amplifier tubes vary by more than 10 ma when meter switch 150 is transferred from one of its positions to the other.	Defective or improperly tuned PN-9-A, or PN-9-B, PN-8-A, or PN-8-B, improperly neutralized.
32	Grid current of final amplifier tubes in PN-8-A, or PN-8-B below 3 ma with meter switch 149 either in G1 or G2 position.	Defective or improperly tuned PN-9-A, or PN-9-B, PN-8-A, or PN-8-B, improperly neutralized.
33	Grid current of final amplifier tubes varies by more than 3 ma when meter switch 149 is transferred from G1 to G2 position.	Defective Tube VT-204. Open resistor 143-3, 143-4, 144-1 to 144-4 inclusive.
34	Operation of PN-8-A, or PN-8-B, erratic or panel can not be neutralized.	Loose mechanical coupling between neutralizing capacitor 131*a* and 131*b*. Open resistor 141-2. Defective tube.
35	Plate circuit of PN-8-A, or PN-8-B, (tuned by ANODE dial) will not cover frequency range.	Plate-line shorting bar in wrong position. Check alignment of anode tuning capacitor 129.

Test No.	*Trouble*	*Probable Cause*
36	Unstable tuning and operation of the amplifier panel.	Defective filament by-pass capacitor 121-1 to 121-4 inclusive. Defective resistor 141-2.
37	PN-8-A, or PN-8-B cathode current incorrect when COUPLING dial is adjusted. The load does not increase sufficiently when coupling is increased.	AERIAL dial on PN-8-A, or PN-8-B not properly tuned. Defective antenna, transmission line, or transmission line socket. Shorted or open antenna-tuning circuits; check flexible coupling strips.
38	Low or zero diode current (less than .8 ma) with meter switch 149 on MON.	No r-f output from transmitter, short-circuited antenna transmission line, defective Tube VT-94 in PN-8-A, or PN-8-B, defective capacitor 123-1, 123-2, or switch 149; open resistor 141-1, open choke 134-2, 134-3 or 134-4.
39	No output obtained from MONITOR TEL. jack on PN-8-A, or PN-8-B.	Defective jack 133, open resistor 142 or 141-1, open choke 134-2, 134-3 or 134-4; defective Tube VT-94 or capacitor 123-1, 123-2, or shorted capacitor 124.
40	Tuning of PN-8-A, or PN-8-B, ANODE dial is unstable and accompanied by considerable backlash.	No lubricant on guide rods of capacitor 129 or on cam-and-ball joints. Relubricate very sparingly. Recenter guide pins if necessary.
41	PN-8-A, or PN-8-B ANODE dial will not tune properly at some points of dial or final amplifier cathode.	Dirt between cylinders of capacitor 129, or cylinders not properly aligned, resulting in short circuit.
42	Tube VT-204 in PN-8-A, or PN-8-B, has unusually short life.	PN-8-A, or PN-8-B tuned with TUNE-OPERATE switch on PN-11-A set at OPERATE, thus allowing plate circuit (ANODE dial on PN-8-A, or PN-8-B), to remain untuned with normal grid drive on tube (AMP. GRID dial on PN-8-A, or PN-8-B, tuned).
43	Relays will not operate when LOCAL-REMOTE switch 55 is set at REMOTE.	Defective rectifier 12, short-circuited line to TRANS. AVAILABLE signal lamp.
44	Dials will not turn.	Insufficient clearance between shafts and panel bushing, requiring reaming slightly oversize.

36. TROUBLE ANALYSIS BY VOLTAGE TESTS.

The d-c voltage measurements in this paragraph are to be made with a d-c voltmeter having a sensitivity of 1,000 ohms per volt or greater, and sufficient ranges to cover 0-1000 volts. The a-c voltage measurements are to be made with an a-c voltmeter having a sensitivity of 200 ohms per volt or greater, and a range of 0-300 volts. The RCA VoltOhmyst, Junior and the Supreme Model 504-A Set Tester are suitable for these tests. Test conditions are as follows:

The transmitter is to be properly tuned as described in paragraphs 15, 16, 17, and 18. Open the rear door of Cabinet CS-88-A, but keep the door interlock switch closed by means of a jumper connected between terminals 25 and 26 on Control Panel PN-11-A. All panels of the transmitter must be properly interconnected. Transmitter must be connected to 110/125-volt power source. Unless otherwise specified, voltages should not deviate by more than 10%. Unless otherwise specified, the TUNE-OPERATE switch should be set at OPERATE, and the LOCAL-REMOTE switch should be set at LOCAL.

Test No.	*Voltage Across Terminals*	*Additional Test Conditions*	*Volts*	*Probable Cause of Incorrect Reading*
1	1 and 2 of PN-13-A, or PN-13-B.		110/125 a-c	Defective wiring.
2	Top of fuses 111-1, 111-2.		110/125 a-c	Open fuse 111-1 or 111-2
3	2 and 3 of autotransformer.		110/125 a-c	Same as 1 and 2. Defective switch 116.
4	1 and 3 of autotransformer.		220/250 a-c	Same as 3. Defective autotransformer.
5	5 and 6 of PN-13-A, or PN-13-B.		230 a-c	Same as 4. Defective variac 117.
6	1 and 2 of PN-11-A.		230 a-c	Same as 5. Defective wiring between PN-11-A and PN-13-A, or PN-13-B.
7	11 and 12 of PN-11-A.		230 a-c	Defective fuses 2-1, 2-2, 4-1, 4-2. Open MASTER FILAMENTS switch 13-1, open R. F. FILAMENTS switch, defective PN-11-A
8	13 and 14 of PN-11-A.		230 a-c	Same as 6. Defective fuses 2-1, 2-2, 4-1, 4-2. Open MASTER FILAMENTS switch 13-1, open A.F. FILAMENTS switch, defective PN-11-A.
9	16 and 17 of PN-11-A.		230 a-c	Defective R.F.H.V. switch. TUNE-OPERATE switch 14, fuse 2-1 or 2-2, MASTER FILAMENTS switch 13-1, MASTER H.V. switch 13-2, fuse 3-1 or 3-2, or contactor 6. (Check contactor by closing it with an insulated rod. If this corrects faulty reading, then contactor or associated circuit is defective.)
10	15 and 17 of PN-11-A.	TUNE-OPERATE switch set at TUNE.	230 a-c	Same as 9.
11	19 and 20 of PN-11-A.		230 a-c	Same as 9 except A.F.H.V. switch is substituted for R.F.H.V. switch.

Test No.	*Voltage Across Terminals*	*Additional Test Conditions*	*Volts*	*Probable Cause of Incorrect Reading*
12	34 and 35 of cabinet terminal board.	LOCAL-REMOTE switch set at REMOTE.	24 d-c	Same as 6. Open fuse 2-1 or 2-2, open MASTER FILAMENTS switch 13-1, defective transformer 16 in PN-11-A, defective rectifier 12 or relay 7. Check wiring between terminals 21 and 22 of control panel. Grounded microphone circuit on PN-10-A, or PN-10-B.
13	23 and 24 of PN-11-A.	LOCAL-REMOTE switch set at REMOTE.	24 d-c	Same as 6. Open fuse 2-1 or 2-2, open MASTER FILAMENTS switch, defective transformer 16, rectifier 12, or shorted capacitor 1-1, 1-2. Defective choke 9, relay 8, open winding in coil of relay 7. Check for external short by removing wires from terminals 23 and 24.
14	2 and 3 of lower PN-12-A.		230 a-c	Same as 11. Defective wiring between terminals 16 and 17 on PN-11-A and 2 and 3 on lower PN-12-A.
15	4 and 5 of lower PN-12-A.		230 a-c	Same as 7. Defective wiring between terminals 4 and 5 of lower PN-12-A and terminals 11 and 12 of PN-11-A.
16	7 and 8 of PN-11-A.		4 a-c	Same as 14. Defective plate transformer 98 in lower PN-12-A. Defective wiring between terminals 10 and 11 of lower PN-12-A and terminals 7 and 8 of PN-11-A.
17	3 and 4 of PN-11-A.		4 a-c	Same as 15. Defective filament transformer 97 in lower PN-12-A, defective wiring between terminals 10 and 11 in lower PN-12-A and 3 and 4 of PN-11-A.
18	14 and 17 of lower PN-12-A.		800 d-c	Same as 14 and 15. Defective Tubes VT-145, open choke 94-1, shorted capacitor 91 or 92 or shorted external circuit. Remove and check external wiring.
19	14 and 16 of lower PN-12-A.		395 d-c	Same as 18. Open choke 94-2.

Test No.	*Voltage Across Terminals*	*Additional Test Conditions*	*Volts*	*Probable Cause of Incorrect Reading*
20	14 and 15 of lower PN-12-A.		315 d-c	Same as 19. Defective resistor 96.
21	2 and 3 of upper PN-12-A.		230 a-c	Same as 11. Defective wiring between terminals 2 and 3 of upper PN-12-A.
22	4 and 5 of upper PN-12-A.		230 a-c	Same as 8. Defective wiring between terminals 4 and 5 of upper power supply panel and 3 and 4 of PN-11-A.
23	9 and 10 of PN-11-A.		4 a-c	Same as 21. Defective plate transformer 98 of upper PN-12-A. Defective wiring between terminals 12 and 13 of upper PN-12-A and 9 and 10 of PN-11-A.
24	5 and 6 of PN-11-A		4 a-c	Same as 22. Defective filament transformer 97, defective wiring between terminals 10 and 11 of PN-12-A and 5 and 6 of PN-11-A.
25	14 and 17 of upper PN-12-A.		850 d-c	Same as 21 and 22. Defective Tubes VT-145, open choke 94-1, shorted capacitor 91 or 92, shorted external circuit. Remove and check external wiring.
26	14 and 15 of upper PN-12-A.		260 d-c	Defective resistor 96.
27	4 and 5 of PN-10-A, or PN-10-B.		230 a-c	Same as 8. Defective wiring between terminals 13 and 14 of PN-11-A and 4 and 5 of PN-10-A, or PN-10-B.
28	15 and 16 of PN-10-A, or PN-10-B.	LOCAL-REMOTE switch set at REMOTE.	24 d-c	Same as 13. Defective wiring between terminals 15 and 16 of PN-10-A, or PN-10-B and 23 and 24 of PN-11-A.
29	36 and 37 of cabinet terminal board.	LOCAL-REMOTE switch set at REMOTE.	24 d-c	Same as 28. Defective wiring between terminals 13 and 14 on PN-10-A, or PN-10-B and 36 and 37 on cabinet terminal board. Defective microphone transformer 56 in PN-10-A, or PN-10-B. Defective REMOTE-LOCAL switch 55 in PN-10-A, or PN-10-B.
30	2 and 7 of PN-10-A, or PN-10-B.		260 d-c	Same as 27. Defective wiring between terminals 14 and 15 of upper PN-12-A and terminals 2 and 7 of PN-10-A, or PN-10-B.

Test No.	*Voltage Across Terminals*	*Additional Test Conditions*	*Volts*	*Probable Cause of Incorrect Reading*
31	2 and 17 of PN-10-A, or PN-10-B.		850 d-c	Same as 25. Defective wiring between terminals 17 of PN-10-A, or PN-10-B and 17 of upper PN-12-A.
32	2 and 18 of PN-10-A, or PN-10-B.		800 d-c	Same as 18. Defective wiring between terminal 18 of PN-10-A, or PN-10-B, and 17 of lower PN-12-A. Short circuit in transformer 59 in PN-10-A, or PN-10-B or defective wiring to transformer.
33	2 and 19 of PN-10-A, or PN-10-B.		800 d-c	Same as 32. Open secondary of transformer 59 of PN-10-A, or PN-10-B.
34	4 and 5 of PN-9-A, or PN-9-B.		230 a-c	Same as 7. Defective wiring between terminals 11 and 12 of PN-11-A and 4 and 5 of PN-9-A, or PN-9-B.
35	12 and 13 of PN-9-A, or PN-9-B.		0 d-c	Broken jumper between terminals 12 and 13 of PN-9-A, or PN-9-B.
36	11 and 13 of PN-9-A, or PN-9-B.		315 d-c	Same as 20. Defective wiring between terminals 14 and 15 on lower PN-12-A and 11 and 13 of PN-9-A, or PN-9-B.
37	11 and 14 of PN-9-A, or PN-9-B.		395 d-c	Same as 19. Defective wiring between terminals 14 and 16 of lower PN-12-A and 11 and 14 of PN-9-A, or PN-9-B.
38	14 and 15 on PN-9-A, or PN-9-B.		0 d-c	Broken or open jumper between terminals 14 and 15 of PN-9-A, or PN-9-B.
39	14 and 16 on PN-9-A, or PN-9-B.		0 d-c	Same as 38. Broken jumper between terminals 15 and 16 of PN-9-A, or PN-9-B.
40	11 and 17 on PN-9-A, or PN-9-B.		800 d-c	Same as 18. Defective wiring between terminals 17 of lower PN-12-A and 17 of PN-9-A, or PN-9-B.
41	4 and 5 of PN-8-A, or PN-8-B.		230 a-c	Same as 34. Defective wiring between terminals 4 and 5 of PN-8-A, or PN-8-B and terminals 4 and 5 of PN-9-A, or PN-9-B.
42	2 and 17 of PN-8-A, or PN-8-B.		800 d-c	Same as 33. Defective wiring between terminals 19 of PN-10-A, or PN-10-B, and 17 of PN-8-A, or PN-8-B.

Test No.	*Voltage Across Terminals*	*Additional Test Conditions*	*Volts*	*Probable Cause of Incorrect Reading*
43	9 and 10 of PN-8-A, or PN-8-B.	Transmitter tone-modulated 100%	More than 1 a-c	Open resistor 141-1, open choke 134-2, 134-3, 134-4. Defective Tube VT-94, defective capacitor 123-1, 123-2, or 124.
44	Jack 133 of PN-8-A, or PN-8-B.	Transmitter tone-modulated 100%	More than 1.5 a-c	Open resistor 141-1, open choke 134-2, 134-3, 134-4. Defective Tube VT-94, capacitor 123-1 or 123-2. Defective jack 133, open resistor 142.

37. VACUUM TUBE SOCKET VOLTAGES AND RESISTANCES.

a. GENERAL.—The vacuum tube socket and terminal strip voltage and resistance values given in this paragraph are correct for normal operating conditions. If measured values vary more than ten per cent from the values listed, it is sufficient cause for investigating the condition of the tube or circuit in question. Unless otherwise stated, leave tubes in place. Make all resistance measurements with power turned off. To make voltage or resistance measurements, follow directions given with each table, and refer to the tube base chart, figure 21. To make socket terminal measurements, set the equipment up as follows:

(1) Disconnect wiring harness from terminal strip at rear of panel.

(2) Remove panel from rack and support it at rear of cabinet, so that wiring can be reattached to terminal strip.

(3) Reattach wiring to terminal strip. Extend wiring if necessary by attaching the necessary length of wire between the terminal stud and the soldering lug on the rack wiring. Tape joints as necessary.

(4) To make grid and plate measurements on Amplifier Panel PN-8-A, or PN-8-B follow instructions with table and leave panel in place in rack.

(5) To make Tube VT-204 heater terminal measurements on Amplifier Panel PN-8-A, or PN-8-B, proceed as in paragraph 37*a*(1), (2), (3), and then remove bottom plate.

(6) To remove Tube VT-204 from chassis, remove plate and grid leads by loosening set screws and removing terminals from tube terminals. While pushing down on both high sides of spring ring, lift tube straight up. In replacing tube in socket, no pressure on spring ring is required. In replacing plate and grid leads, *just barely tighten the set screws*. Excessive pressure may break the plate or grid lead, and may break the tube seal.

(7) To remove Tube VT-175 or VT-66 and Tube VT-94 from chassis, draw tube straight up while holding spring clip away from tube. Hold clip just far enough to clear shoulder at bottom of tube.

(8) To remove Tube VT-100 and Tube VT-217, remove plate lead from top cap and move handle of tube clamp to right. Tube can then be drawn straight up.

(9) To remove Tube VT-145, move handle of tube clamp to right and draw tube straight up.

b. POWER SUPPLY PANEL PN-12-A (LOWER).

CAUTION

DO NOT ATTEMPT TO MEASURE FILAMENT VOLTAGE WHILE PLATE VOLTAGE IS APPLIED TO RECTIFIER TUBES. *Press the PRESS OFF button of the MASTER H.V. switch on Control Panel PN-11-A.*

Adjust the VOLTAGE INCREASE wheel on Power Control Panel PN-13-A, or PN-13-B, until the OUTPUT VOLTAGE meter indicates 230 volts a-c (red calibration line). Check OUTPUT VOLTAGE meter frequently, and always after any adjustment, since adjustment can vary the load. If the power supply panel has been removed from the rack, connect proper rack wires to terminals 1, 2, 3, 4, and 5 on the terminal strip. Three terminals must be loaded by connecting a resistor between the terminal and ground, as follows:

Terminal 15 to chassis: 13,500 ohms, 15 watts.

Terminal 16 to chassis: 3,000 ohms, 75 watts.

Terminal 17 to chassis: 4,300 ohms, 200 watts.

(1) Measured voltages should conform within 10 per cent with those shown in the table.

Tube	*Socket*	*Filament Volts (a-c)*
VT-145	99-1	5.0
VT-145	99-2	5.0
VT-145	99-3	5.0
VT-145	99-4	5.0

Terminals	*Volts*
*17 to chassis	800 d-c
16 to chassis	395 d-c
15 to chassis	315 d-c
12 to 13	4.0 a-c
10 to 11	4.0 a-c
†17 to chassis	400 d-c

*A common fault found in Power Supply Panel PN-12-A is a high-voltage breakdown between tube socket and chassis.

†Set TUNE-OPERATE switch at TUNE.

(2) The resistance measurements in the table below were made with all load resistors and rack wiring disconnected, and the chassis removed from the rack.

Tube	*Socket*	*Filament to Chassis (Ohms)*	*Plate to Chassis (Ohms)*
VT-145	99-1	17,500	9,500
VT-145	99-2	17,500	9,500
VT-145	99-3	9,500	0
VT-145	99-4	9,500	0

Terminals	*Resistance*
15 to chassis	8,000
16 to chassis	9,500
17 to chassis	17,500

c. POWER SUPPLY PANEL PN-12-A (UPPER).

DO NOT ATTEMPT TO MEASURE FILAMENT VOLTAGE WHILE PLATE VOLTAGE IS APPLIED TO RECTIFIER TUBES. *Press the PRESS OFF button of the MASTER H.V. switch on Control Panel PN-11-A.*

Adjust the VOLTAGE INCREASE wheel on Power Control Panel PN-13-A, or PN-13-B, until the OUTPUT VOLTAGE meter indicates 230 volts a-c, (red calibration line). Check OUTPUT VOLTAGE meter frequently, and always after any adjustment, since adjustment can vary the load. If the power supply panel has been removed from the rack, connect proper rack wires to terminals 1, 2, 3, 4, and 5 on the terminal strip. Loads must be connected to two of the terminals, as follows:

Terminal 17 to chassis: 8,500 ohms, 200 watts.

Terminal 15 to chassis: 3,700 ohms, 25 watts.

Terminal 16 is not used on the upper power supply panel.

(1) Measured voltages should conform within 10 per cent with those shown in the table.

Tube	*Socket*	*Socket Terminals*	*Filament Volts (a-c)*
VT-145	99-1	1 & 4	5.0
VT-145	99-2	1 & 4	5.0
VT-145	99-3	1 & 4	5.0
VT-145	99-4	1 & 4	5.0

Terminals	*Volts*
17 to chassis	850 d-c
16 to chassis	425 d-c
15 to chassis	260 d-c
12 to 13	4.0 a-c
10 to 11	4.0 a-c

(2) The resistance-measurement procedure and data for this panel are identical with that given in paragraph 37b (2).

d. **MODULATOR PANEL PN-10-A, AND PN-10-B.**

(1) The voltage tests in the table below were made with the modulator panel removed from the rack and supported at the rear, with all rack wiring connected to the proper terminals. The LOCAL-REMOTE switch was set to REMOTE, and a microphone in series with a 500-ohm, 10-watt resistor was connected across terminals 36 and 37 of the cabinet terminal board. Power was turned on, the OUTPUT VOLTAGE meter reading was maintained at 230 volts, and the transmitter was unmodulated. Measurements were made between tube socket terminals and ground. The plate current given in the right-hand column can be measured on Modulator Panel PN-10-A on the MODULATOR ANODE CURRENT meter. On Modulator Panel PN-10-B, it can be measured on the M.A. CURRENT meter by turning the METER RANGE-MILLIAMPERES switch to MOD.

Tube	*Function*	*Socket*	*Heater Voltage*	*Plate Voltage (d-c)*	*Plate Current (ma)**
VT-94	1st Audio	62-1	6.3	240	9
VT-94	1st Audio	62-2	6.3	240	9
VT-175 or VT-66	Driver	62-3	6.3	260	37
VT-175 or VT-66	Driver	62-4	6.3	260	37
VT-217	Modulator	63-1	6.3	850	15
VT-217	Modulator	63-2	6.3	850	15
VT-94	Audio Osc.	62-5	6.3	250	.2

*With 100% modulation a current of 110 ma is indicated on the MODULATOR ANODE CURRENT meter.

(2) The following resistances in ohms were measured from the tube-socket terminals to ground with power turned off and the modulator panel removed and disconnected from the rack. The audio oscillator volume control and the VOLUME CONTROL were set fully clockwise. Tubes were not in sockets.

Tube	*Function*	*Socket*	*Heaters*	*Grid (Ohms)*	*Plate*	*Cathode (Ohms)*
VT-94	1st Audio	62-1	—	10,000	Inf.	500
VT-94	1st Audio	62-2	—	10,000	Inf.	500
VT-175 or VT-66	Driver	62-3	—	750	Inf.	325
VT-175 or VT-66	Driver	62-4	—	750	Inf.	325

Tube	Function	Socket	Heaters	Grid (Ohms)	Plate	Cathode (Ohms)
VT-217	Modulator	63-1	0.3	50	Inf.	—
VT-217	Modulator	63-2	0.3	50	Inf.	—
VT-94	Audio Osc.	62-5	0 or .2	1Meg	Inf.	0

e. OSCILLATOR PANEL PN-9-A, and PN-9-B.

(1) The following voltages were measured between the tube socket terminals and the chassis, with the chassis removed from the rack and supported at the rear, and with all rack wiring connected to the proper terminals. The transmitter must be properly tuned, as described in paragraphs 15, 16, 17, and 18. Set the **TUNE-OPERATE** switch at **OPERATE** and maintain an **OUTPUT VOLTAGE** meter indication of 230 volts.

Tube	Function	Socket	Filament Voltage (a-c)	Plate Voltage (d-c)	Screen Voltage (d-c)	Cathode Current (ma)	Grid Current
VT-175 or VT-66	CO	197	6.3	315	150	10-15	—
VT-100	T1	198	6.3	395	150	30-40	—
VT-204	T2	199-1	6.3	395	—	45-60	—
VT-204	D	199-2	6.3	395	—	54-65	—
VT-204	IPA	199-3	6.3	800	—	50-70	8-15 ma

(2) The following resistance measurements were made between tube socket terminals and ground with all power turned off and oscillator panel removed from rack. All rack wiring was disconnected from the oscillator panel terminal strip.

NOTE

MAKE CERTAIN METER SWITCH IS NOT SET TO CIRCUIT BEING MEASURED.

Tube	Function	Socket	Filament	Plate	Grid	Screen	Cathode
VT-175 or VT-66	CO	197	—	Inf.	100,000	Inf.	50
VT-100	T1	198	—	Inf.	25,000	Inf.	1050
VT-204	T2	199-1	1050	Inf.	25,000	—	—
VT-204	D	199-2	50	Inf.	15,000	—	—
VT-204	IPA	199-3	175	Inf.	10,000	—	—

f. AMPLIFIER PANEL PN-8-A, and PN-8-B.

(1) Except as otherwise noted, the following measurements were made with panel in place and with transmitter properly tuned, as described in paragraphs 15, 16 and 17. Adjust **VOLTAGE INCREASE** wheel

for an OUTPUT VOLTAGE meter indication of 230 volts. Do not modulate the transmitter. Connect a 110/120-volt, 60-watt incandescent bulb between the antenna terminal center electrode and ground (chassis), to serve as a load.

Tube	*Function*	*Socket*	*Beater Voltage (a-c)*	*Plate Voltage (d-c)*	*Cathode Current (ma)*	*Grid Current (ma)*	*Plate Current*
VT-204	PA	147-1	6.3*	800	C1, 70-78	G1, 10-18	—
VT-204	PA	147-2	6.3*	800	C2, 70-78	G2, 10-18	—
VT-94	MON	148	6.3*	—	—	—	1.6 ma

*For these tests remove rack wiring from terminal strip, set coupling dial at 100, remove panel from rack, remove bottom cover, and apply 230 volts a-c to terminals 4 and 5 on the panel terminal strip.

(2) The following resistances were measured from the tube socket terminals to the chassis with the panel removed from the rack and all rack wiring disconnected from the amplifier panel. Tubes were in place.

NOTE

MAKE CERTAIN METER SWITCH IS NOT SET TO CIRCUIT BEING MEASURED.

Tube	*Function*	*Socket*	*Heater (Ohms)*	*Plate (Ohms)*	*Grid (Ohms)*
VT-204	PA	147-1	50	Inf.	10,050
VT-204	PA	147-2	50	Inf.	10,050
VT-94	MON	148	—	50	50

38. INTERPANEL WIRING CONTINUITY TESTS.

The procedure for testing continuity of rack wiring of Radio Transmitter BC-640-A is almost identical with the procedure for testing Radio Transmitter BC-640-B. In the latter three wires are provided which do not occur in Radio Transmitter BC-640-A. These are examined in tests 10, 11, and 12 in the table, and are marked with an asterisk.

Test No.	*From Terminal*	*On*	*To Terminals*	*On*	*Color Code*
1	Ground stud	CS-88-A	Chassis stud	PN-8-A, or PN-8-B	White-black
2	Ground stud	CS-88-A	Chassis stud	PN-9-A, or PN-9-B	White-black
3	Ground stud	CS-88-A	Chassis stud	PN-10-A, or PN-10-B	White-black
4	Ground stud	CS-88-A	Chassis stud	PN-11-A	White-black
5	Ground stud	CS-88-A	Chassis stud	Upper PN-12-A	White-black
6	Ground stud	CS-88-A	Chassis stud	Lower PN-12-A	White-black

Test No.	*From Terminal*	*On*	*To Terminal*	*On*	*Color Code*
7	Ground stud	CS-88-A	Chassis stud	PN-13-A, or PN-13-B	White-black
8	4	PN-8-A, or PN-8-B	4	PN-9-A, or PN-9-B	White-black and green
9	5	PN-8-A, or PN-8-B	5	PN-9-A, or PN-9-B	White-black and red
*10	6	PN-8-B	6	PN-9-B	White-brown and red
*11	7	PN-8-B	7	PN-9-B	White-red and green
*12	8	PN-8-B	8	PN-10-B	White-brown and blue
13	9	PN-8-A, or PN-8-B	38	Cabinet terminal board	White-red and yellow
14	10	PN-8-A, or PN-8-B	39	Cabinet terminal board	White-black and orange
15	14	PN-8-A, or PN-8-B	11	PN-9-A, or PN-9-B	White-black and yellow
16	17	PN-8-A, or PN-8-B	19	PN-10-A, or PN-10-B	White-red, yellow and green
17	4	PN-9-A, or PN-9-B	12	PN-11-A	White-black and green
18	5	PN-9-A, or PN-9-B	11	PN-11-A	White-black and red
19	11	PN-9-A, or PN-9-B	14	Lower PN-12-A	White-black and yellow
20	12	PN-9-A, or PN-9-B	13	PN-9-A, or PN-9-B	Bare
21	14	PN-9-A, or PN-9-B	15	PN-9-A, or PN-9-B	Bare
22	15	PN-9-A, or PN-9-B	16	PN-9-A, or PN-9-B	Bare
23	13	PN-9-A, or PN-9-B	15	Lower PN-12-A	White-red and yellow
24	14	PN-9-A, or PN-9-B	16	Lower PN-12-A	White-red and green
25	17	PN-9-A, or PN-9-B	18	PN-10-A, or PN-10-B	White-red and orange
26	2	PN-10-A, or PN-10-B	14	Upper PN-12-A	White-black
27	4	PN-10-A, or PN-10-B	14	PN-11-A	White-black and green
28	5	PN-10-A, or PN-10-B	13	PN-11-A	White-black and red
29	7	PN-10-A, or PN-10-B	15	Upper PN-12-A	White-red and yellow
30	13	PN-10-A, or PN-10-B	36	Cabinet terminal board	Yellow
31	14	PN-10-A, or PN-10-B	37	Cabinet terminal board	Green
32	15	PN-10-A, or PN-10-B	24	PN-11-A	White-brown, orange, and green
33	16	PN-10-A, or PN-10-B	23	PN-11-A	White-brown, orange, and yellow

*Radio Transmitter BC-640-B only

Test No.	*From Terminal*	*On*	*To Terminal*	*On*	*Color Code*
34	17	PN-10-A, or PN-10-B	17	Upper PN-12-A	White-red and blue
35	18	PN-10-A, or PN-10-B	17	Lower PN-12-A	White-blue
36	1	PN-11-A	6	PN-13-A, or PN-13-B	White-brown
37	2	PN-11-A	5	PN-13-A, or PN-13-B	White-red
38	3	PN-11-A	11	Lower PN-12-A	White-black and brown
39	4	PN-11-A	10	Lower PN-12-A	White-black and brown
40	5	PN-11-A	11	Upper PN-12-A	White-black and yellow
41	6	PN-11-A	10	Upper PN-12-A	White-black and yellow
42	7	PN-11-A	13	Lower PN-12-A	White-brown and red
43	8	PN-11-A	12	Lower PN-12-A	White-brown and red
44	9	PN-11-A	13	Upper PN-12-A	White-brown and blue
45	10	PN-11-A	12	Upper PN-12-A	White-brown and blue
46	11	PN-11-A	5	Lower PN-12-A	White-black and red
47	12	PN-11-A	4	Lower PN-12-A	White-black and green
48	13	PN-11-A	5	Upper PN-12-A	White-black and red
49	14	PN-11-A	4	Upper PN-12-A	White-black and green
50	15	PN-11-A	1	Lower PN-12-A	White-blue
51	16	PN-11-A	2	Lower PN-12-A	White-red and blue
52	17	PN-11-A	3	Lower PN-12-A	White-red and orange
53	19	PN-11-A	2	Upper PN-12-A	White-brown
54	20	PN-11-A	3	Upper PN-12-A	White-red
55	21	PN-11-A	35	Cabinet terminal board	White-black
56	22	PN-11-A	34	Cabinet terminal board	White-yellow
†57	25	PN-11-A	26	PN-11-A	
58	1	PN-13-A, or PN-13-B	L.h. 110/125v	Cabinet terminal board	White-black and red
59	2	PN-13-A, or PN-13-B	R.h. 110/125v	Cabinet terminal board	White-black and green
60	3	PN-13-A, or PN-13-B	L.h. 220/250v	Cabinet terminal board	White-red and blue

†Should show continuity when door interlock switch is operated manually, and should show no connection when switch is unoperated.

Test No.	*From Terminal*	*On*	*To Terminal*	*On*	*Color Code*
61	4	PN-13-A, or PN-13-B	R.h. 220/250v	Cabinet terminal board	White-red and orange
62	7	PN-13-A, or PN-13-B	1	Autotransformer	White, black, brown, and red
63	8	PN-13-A, or PN-13-B	2	Autotransformer	White-black, brown, and yellow
64	9	PN-13-A, or PN-13-B	3	Autotransformer	White-black, brown, and blue

39. REPLACEMENTS.

a. RELAYS.—Do not attempt to repair or adjust relays. If a relay is defective replace with a new relay unit.

b. VACUUM TUBES.—Replace as described in paragraph 37 (6), (7), (8), and (9). It is desirable to replace the two tubes, Tube VT-204, in Amplifier Panel PN-8-A together since they are used in a balanced circuit where the characteristics of the two tubes must be nearly equal. If these tubes are replaced, readjust plate line shorting bar as described in paragraph 15f (2). Retune transmitter if any r-f tubes are replaced.

c. PILOT BULBS.

(1) Remove the glass cap and burned out bulb from the front panel with the tools provided for this purpose.

(2) Replace pilot bulbs on Control Panel PN-11-A, or PN-11-B with 4v, .210a bulbs.

(3) Replace pilot bulbs on Power Control Panel PN-13-A, or PN-13-B with a 150v, 6w, clear bulb.

d. FUSES.

(1) Shut off power to transmitter before installing new fuses.

(2) Be sure cause for burned out fuse is removed before replacing.

(3) Positions of fuses and their ratings are plainly marked at rear of transmitter for easy replacement, see figures 25 and 30.

e. INTERCHANGEABILITY OF PANELS.

Panel	*Substitute Panel*	*Effects on Operation*
PN-8-B (Amplifier Panel)	PN-8-A	*Combination not permitted* because of meter circuit required for PN-9-B and PN-10-B.
PN-8-A	PN-8-B	Combination will work. However, the meter switch will not be effective on 3 positions. This would be satisfactory on BC-640-A equipment without changing the interpanel wiring cable.
PN-9-B (Oscillator Panel)	PN-9-A	Satisfactory substitution. However, meter switch on PN-8-B will not be connected to the oscillator panel. Therefore, not being effective on two positions.
PN-9-A	PN-9-B	This is not satisfactory. PN-9-B is not interchangeable on BC-640-A because meters are not used on PN-9-B and must be used with Panel PN-8-B.
PN-10-B	PN-10-A	Satisfactory substitution, meter switch on PN-8-B will not be effective on one position.
PN-10-A	PN-10-B	Not satisfactory. PN-9-B cannot be used on BC-640-A equipment unless PN-8-B panel is used.
PN-13-B	PN-13-A	Satisfactory unless lock for Variable Transformer is desired.
PN-13-A	PN-13-B	Satisfactory, no electrical changes.

f. **METER.**—If the meter is replaced in transmitter BC-640-B, the meter must have a total resistance of 4 ohms. All meters manufactured by Triplett have 4 ohms internal resistance. Meters which do not have 4 ohms internal resistance are supplied with a bakelite terminal board on the back of the meter on which is mounted a resistor to make a total of 4 ohms. The value of this resistor is as follows:

Manufacturer	*Internal Resistance of Meter*	*Value of Resistance*
Weston	1.2 ohms	2.8 ohms
General Electric	2.3 ohms	1.7 ohms
Westinghouse	.6 ohms	3.4 ohms

All 0-25 ma. d-c meters marked "INTERNAL RESISTANCE 4 OHMS", regardless of manufacture may be used without any external resistor.

SECTION VI

SUPPLEMENTARY DATA

40. SUMMARY.

Type of operation	Radiophone or M.C.W.
Type of control	Remote or Local
2 Crystal frequency range	5555.5 to 8666.6 kc ($1/18$ of transmitter output)
2 Output frequency range	100 to 156 mc (3 meters to 1.96 meters)
Primary power source	110 to 125 volts or 220 to 250 volts 50 to 60 cycles, single phase a-c

a. TOTAL POWER REQUIRED FROM LINE:

Unmodulated	*Modulated 100 per cent*
.891 kva	.918 kva
815 watts	860 watts
91.5 per cent power factor	93.8 per cent power factor

Approximate power supply output 315, 395 and 800 volts d-c, gives the following r-f output to transmission line terminals:

51.5 watts	100 to 125 mc
50.0 watts	140 mc
46.0 watts	156 mc

Other frequencies have comparable output.

b. TUBE COMPLEMENT.

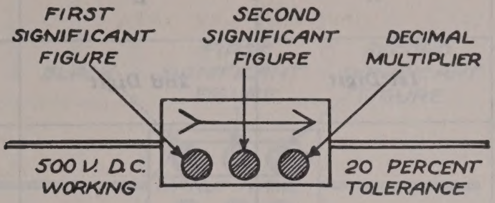
Quantity	*Mfg. Type*	*Function*	*Sig. Corps No.*
8	5Z3	High-vacuum rectifier	VT-145
5	HK-24-G	R-F triode	VT-204
4	6J5	High-mu metal triode	VT-94
*3	1613	R-F and A-F metal pentode	VT-175 or VT-66
1	807	R-F beam power	VT-100
2	811	Zero bias class B amplifier	VT-217

*Two of these tubes used in Modulator Panel PN-10-A, or PN-10-B may be Tube VT-66 (6F6).

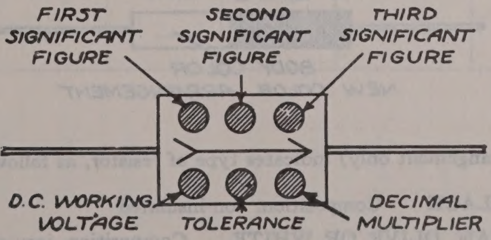
c. FUSES.—Power input 110/125 volts, 10 amperes.
Power input 220/250 volts, 5 amperes.
Plate and filament supply, 5 amperes.
Plate supply, 3 amperes.
Filament supply, 2 amperes.

d. PILOT LIGHTS.—Control panel 4 volts, .210 amperes.
Power-control panel, 150 volts, 6 watts.

41. COLOR CODES FOR RESISTORS AND CAPACITORS.


FIRST SIGNIFICANT FIGURE
SECOND SIGNIFICANT FIGURE
DECIMAL MULTIPLIER
500 V. D.C. WORKING
20 PERCENT TOLERANCE

Color	*Numeral*	*Volts*	*Multiplier*	*Tolerance*
Black	0		1	
Brown	1	100	10	1%
Red	2	200	100	2%
Orange	3	300	1,000	3%
Yellow	4	400	10,000	4%
Green	5	500	100,000	5%
Blue	6	600	1,000,000	6%
Violet	7	700	10,000,000	7%
Gray	8	800	100,000,000	8%
White	9	900	1,000,000,000	9%
Gold		1000	0.1	5%
Silver		2000	0.01	10%
No Color		500		20%

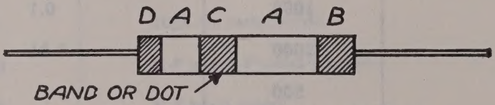

FIRST SIGNIFICANT FIGURE
SECOND SIGNIFICANT FIGURE
THIRD SIGNIFICANT FIGURE
D.C. WORKING VOLTAGE
TOLERANCE
DECIMAL MULTIPLIER

RMA Color Code for Resistors (Ohms)

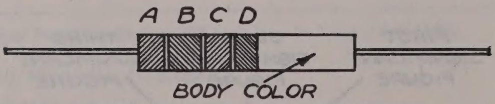
	A	B	C
Color	*1st Digit*	*2nd Digit*	*Multiplier*
Silver			0.01
Gold			0.1
Black		0	1.0
Brown	1	1	10
Red	2	2	100
Orange	3	3	1,000
Yellow	4	4	10,000
Green	5	5	100,000
Blue	6	6	1,000,000
Purple	7	7	10,000,000
Gray	8	8	100,000,000
White	9	9	

D — TOLERANCE CODE:

Gold = 5%	Silver = 10%	No Color = 20%



OLD COLOR ARRANGEMENT

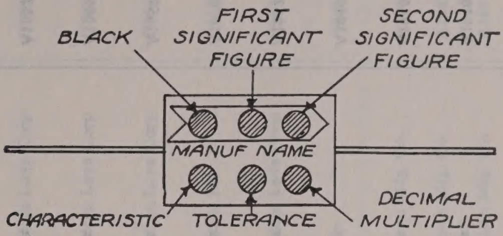


NEW COLOR ARRANGEMENT

Body Color (new color arrangement only) indicates type of resistor, as follows:

BLACK	Composition, non-insulated
TAN, OLIVE OR WHITE	Composition, insulated
DARK BROWN	Wire-wound, insulated

American War Standard 6 Dot Color Code for Capacitors (Molded Mica)


BLACK
FIRST SIGNIFICANT FIGURE
SECOND SIGNIFICANT FIGURE
MANUF NAME
CHARACTERISTIC
TOLERANCE
DECIMAL MULTIPLIER

Color	Significant Figure	Decimal Multiplier	Tolerance	Characteristic	
				Maximum Capacitance Drift	Temperature Coefficient Parts/Million /°C
Black	0	1	—	—	—
Brown	1	10	—	—	—
Red	2	100	2%	0.5%	-200 to +200
Orange	3	1000	—	0.2%	-100 to +100
Yellow	4	—	—	0.05%	0 to 100
Green	5	—	—	0.025%	0 to -50
Blue	6	—	—	—	—
Violet	7	—	—	—	—
Gray	8	—	—	—	—
White	9	—	—	—	—
Gold	—	0.1	5%	—	—
Silver	—	0.01	10%	—	—
Black	—	—	20%	—	—

SECTION VII

TABLE OF REPLACEABLE PARTS

MODEL: RADIO TRANSMITTER BC-640-A AND BC-640-B

Reference Symbol	*Army Stock Number Navy Stock Number British Ref. Number*	*Name or Part and Description*	*Function*	*Mfr. and Desig. or AWS Type*	*Bendix Drawing No.*
	2Z3002.4	CONNECTOR: Flexible; 2" x ¼" x .010"; soft drawn copper strip; silver plated	Connector on oscillator panel	Bendix	A104695-3
	2Z3002.1	CONNECTOR: Flexible; 1¼" x ¼" x .010" soft drawn copper strip; silver plated	Connector on oscillator panel	Bendix	A104695-2
	2Z3002.2	CONNECTOR: Flexible; 3" x ¼" x .010"; soft drawn copper strip; silver plated	Connector on oscillator panel	Bendix	A104695-5
	2Z3002.3	CONNECTOR: Flexible; 1" x ¼" x .010"; soft drawn copper strip; silver plated	Connector on oscillator panel	Bendix	A104695-7
	2Z3002.7	CONNECTOR: 1⅛" x 5/16" x .005"; nickel silver	Connector tube Power Amp.	Bendix	A105236
	2Z3002.10	CONNECTOR: 1¼" x ⅛" x .010; phosphor bronze; silver plated	Antenna coupling	Bendix	A107096
	2Z3002.9	CONNECTOR: 1 1/32" x 5/16" x .010"; phosphor bronze; SPG-TEMP; silver plated	Strap power amp.	Bendix	A105297
	2Z3002.6	CONNECTOR: Flexible; 1¾" x ¼" x .010"; soft drawn copper strip; silver plated	Connector oscillator panel	Bendix	A104695-8
	2Z3005-6	CONNECTOR: Brass; ½" dia x 7/16"	Top cap power amp	Bendix	A105234B
	2Z3269-2	COUPLING: ⅞" x 7/32" x 11/32"; copper; silver plated	Amp coupling	Bendix	A105328
	3Z1013.4	FUSE CLIP: Split retainer type; phosphor bronze; #5048	Fuse holder clip	Littelfuse	A5324-4
	2Z3269-1	COUPLING: Shaft; #TX-9; for ¼" shaft	Coupler on oscillator panel	National	A105366
	3G1250-32.3	INSULATOR: Cylindrical; 2" long; ½" dia; tapped #6-32 x ⅜"; Cat. No. 397-L2	Stand off	Isolantite Inc.	C56351-46

	3G1250-16.5	INSULATOR: Cylindrical; 1" long x ½" dia; tapped #6-32 x ⅜"; Cat. No. 397-L1	Stand off	Isolantite Inc	C56351-42
	3G1250-12.2	INSULATOR: Cylindrical; ¾" long x ½" dia; tapped #6-32 x 5/2"; Cat. No. 397-L¾	Stand off	Isolantite Inc	C56351-41
	3G1250-10.5	INSULATOR: ⅝" x ½" dia; 2 holes tapped #8-32 ¼" deep	Post	American Lava Corp	C56352-30
	3G1250-16.9	INSULATOR: 1" x ½" dia; 2 holes tapped #8-32 ⅜" deep	Post	American Lava Corp	C56352-72
	3G1250-10.3	INSULATOR: ⅝" x ½" dia; 2 holes tapped #6-32 ¼" deep; Cat. No. 1405	Post	American Lava Corp	C56352-14
	3G1250-12.5	INSULATOR: ¾" x ½" dia; 2 holes tapped #6-32 ¼" deep	Post	American Lava Corp	C56352-16
	3G1250-8.5	INSULATOR: ½" x ½" dia; 2 holes tapped #6-32 3/16" deep	Post	American Lava Corp	C56352-13
	3G1250-24.12	INSULATOR: 1½" x ½" dia; 2 holes tapped #6-32 ⅜" deep; Cat. No. 397-L1½	Stand off	Isolantite Inc	C56351-44
	3G1250-48.3	INSULATOR: 3" x ½" dia; 2 holes tapped #8-32 ¾" deep; Cat. No. 1005	Post	American Lava Corp	C56352-39
	3G1250-10.1	INSULATOR: Ceramic; ⅝" long x ½" sq; 2 holes tapped #6-32 7/32" deep	Stand off	Bendix	A9393-3
	3Z1026-3	RESISTOR CLIP: 600v; 60 amps; cat. No. 31-60	Split retainer fuse	Sherman Mfg. Co.	A10418-6
	3Z1026-1	RESISTOR CLIP: 250v; 60 amps; cat. No. 31-60	Split retainer fuse	Sherman Mfg. Co.	A10418-4
	3Z1026-2	RESISTOR CLIP: 250v 30 amps; cat. No. 0-30	Split retainer fuse	Sherman Mfg. Co.	A10418-3
	2C6530-640A/L1	LINK ASSEMBLY	Amplifier jack link	Bendix	A105307-1
	3G115-32	BUSHING: Cat. No. 1174	Feed through	Alsimag	A18124-3
	3G115-48	BUSHING: Cat. No. 1175	Feed through	Alsimag	A18124-4
	2Z7699-2.6/3	CONTACT BRIDGING FINGER: Cat. No. 5303307G1	For transmitter control relay	General Electric	A107616-1
	2Z7699-2.6/2	CONTACT: Stationary; front; cat. No. 5375160-63	For transmitter control relay	General Electric	A107616-2

MODEL: RADIO TRANSMITTER BC-640-A AND BC-640-B

Reference Symbol	Army Stock Number Navy Stock Number British Ref. Number	Name of Part and Description	Function	Mfr. and Desig. or AWS Type	Bendix Drawing No.
	2Z7699-2.6/5	CONTACT: Spring; cat. No. 2415331	For transmitter control relay	General Electric	A106616-4
	2Z7699-2.6/4	CONTACT: Stationary; rear; cat. No. 5375160-G4	For transmitter control relay	General Electric	A107616-3
	3Z9857.11	SWITCH: SP normally open; 3 amps at 250 volts; No. 2023E	Interlock on Cabinet CS-88-A Power Supply Panel PN-12-A	H & H	A104654

MODEL: RADIO TRANSMITTER BC-640-A AND BC-640-B

MAJOR ASSEMBLY: CONTROL PANEL PN-11-A

Reference Symbol	Army Stock Number Navy Stock Number British Ref. Number	Name of Part and Description	Function	Mfr. and Desig. or AWS Type	Bendix Drawing No.
1-1	3DB20-4	CAPACITOR: Fixed; 20 mfd; 50v dcw; type EM-50	Microphone filter	Aerovox	A104504
1-2	3DB20-4	CAPACITOR: Same as ref. 1-1	Microphone filter		
1-3	3DB20-4	CAPACITOR: Same as ref. 1-1	Plate relay filter		
1-4	3DB20-4	CAPACITOR: Same as ref. 1-1	Plate relay filter		
2-1	3Z2605.4	FUSE: 5 amp; 250v; Fusetron type 504	A-C input	Bussman	A104542-1
2-2	3Z2605.4	FUSE: Same as ref. 2-1	A-C input		
3-1	3Z2603.9	FUSE: 3 amp; 250v; Fusetron type 403	High voltage supply	Bussman	A104542-2
3-2	3Z2603.9	FUSE: Same as ref. 3-1	High voltage supply		
4-1	3Z2602.5	FUSE: 2 amp; 250v; Fusetron type 402	Filament supply	Bussman	A104542-3
4-2	3Z2602.5	FUSE: Same as ref. 4-1	Filament supply		
5-1	4C9761.3	SOCKET: Lamp, switchboard; supervisory; #13	R-F filament on indicator socket	Stromberg-Carlson	A104502
5-2	4C9761.3	SOCKET: Same as ref. 5-1	A-F filament on indicator socket		
5-3	4C9761.3	SOCKET: Same as ref. 5-1	R-F high voltage on indicator socket		

5-4	4C9761.3	**SOCKET:** Same as ref. 5-1	A-F high voltage on indicator socket		
6	2Z7699-2.6	**RELAY:** 230v; 50-60 cycle; Cat. No. CR2810-1820A66	Plate contactor	General Electric	C58343
7 and 8	3H5011	**RELAY:** Single; 200 ohm coil; quick acting	Signal lamp control and plate control	Stromberg-Carlson	C58363
9	3C336-18	**COIL:** Reactor; choke; 15 henries .08 amp d-c; 100 ohms d-c res	Filter choke	Bendix	A103032
10-1	4C5404	**LAMP:** Pilot; 4v .210 amps; #4-A-2; for transmitter switchboard control unit	R-F filament on	Stromberg-Carlson	A104501
10-2	4C5404	**LAMP:** Same as ref. 10-1	A-F filament on		
10-3	4C5404	**LAMP:** Same as ref. 10-1	R-F high voltage on		
10-4	4C5404	**LAMP:** Same as ref. 10-1	A-F high voltage on		
11	3Z6012-3	**RESISTOR:** Fixed; 120 ohm; 30 watt; type 1¼ BR	Relay current supply bleeder	Hardwick-Hindle	A104505
12	3H4856-2	**RECTIFIER:** Selenium; full wave; bridge type; output 25 v d-c; 1.6 amps	Relay and microphone current	International Telephone	A106056
13-1	3Z9824-270	**SWITCH:** D.P.S.T.; pushbutton type; 250v; 10 amp; type No. 68248	Master filament	General Electric	A104508
13-2	3Z9824-270	**SWITCH:** Same as ref. 13-1	Master high voltage		
14	3Z9862	**SWITCH:** S.P.D.T.; 250v; 5 amp; No. 2514	Tune-operate	General Electric	A104509
15-1	3Z9861-1	**SWITCH:** D.P.S.T.; 250v; 10 amp; No. 1312	R-F filament	Pass & Seymour	A104507-1
15-2	3Z9861-1	**SWITCH:** Same as ref. 15-1	A-F filament		
15-3	3Z9861-1	**SWITCH:** Same as ref. 15-1	R-F high voltage		
15-4	3Z9861-1	**SWITCH:** Same as ref. 15-1	A-F high voltage		
16	2Z9601.3	**TRANSFORMER:** Rectox; 230v 31/29/27v; 50-60 cycle; 15.5 va.	Relay and microphone current	Bendix	A103002
	4C2431C	**LAMP CAP:** Green; type 31C	Filament on indicator	Stromberg-Carlson	A104503-2
	4C2431B	**LAMP CAP:** Red; type 31B	High voltage on indicator	Stromberg-Carlson	A104503-1

MODEL: RADIO TRANSMITTER BC-640-A AND BC-640-B

MAJOR ASSEMBLY: CONTROL PANEL PN-11-A

Reference Symbol	Army Stock Number Navy Stock Number British Ref. Number	Name of Part and Description	Function	Mfr. and Desig. or AWS Type	Bendix Drawing No.
	2Z9428-6	TERMINAL BOARD ASSEMBLY: 28 terminals; six fuse clips	External connections to unit	Bendix	C58342

MODEL: RADIO TRANSMITTER BC-640-A AND BC-640-B

MAJOR ASSEMBLY: MODULATOR PANEL PN-10-A

Reference Symbol	Army Stock Number Navy Stock Number British Ref. Number	Name of Part and Description	Function	Mfr. and Desig. or AWS Type	Bendix Drawing No.
31-1	3D9500-18	CAPACITOR: Fixed; mica; .0005 mfd; ±10%; 1000v dct; type 1468; alternate .00047 ±10%; 1000v dct; ASACM20B471K	Microphone jack r-f bypass	Aerovox	A104591-2
31-2	3D9500-18	CAPACITOR: Same as ref. 31-1	Microphone jack r-f bypass		
31-3	3D9500-18	CAPACITOR: Same as ref. 31-1	Microphone jack r-f bypass		
31-4	3D9500-18	CAPACITOR: Same as ref. 31-1	Microphone jack r-f bypass		
31-5	3D9500-18	CAPACITOR: Same as ref. 31-1	Control circuit r-f bypass		
31-6	3D9500-18	CAPACITOR: Same as ref. 31-1	Control circuit r-f bypass		
31-7	3D9500-18	CAPACITOR: Same as ref. 31-1	Audio input r-f bypass		
31-8	3D9500-18	CAPACITOR: Same as ref. 31-1	Audio input r-f bypass		
31-9	3D9500-18	CAPACITOR: Same as ref. 31-1	MON control r-f bypass		
31-10	3D9500-18	CAPACITOR: Same as ref. 31-1	First audio filament bypass		
31-11	3D9500-18	CAPACITOR: Same as ref. 31-1	First audio filament bypass		
31-12	3D9500-18	CAPACITOR: Same as ref. 31-1	First audio filament bypass		
31-13	3D9500-18	CAPACITOR: Same as ref. 31-1	First audio filament bypass		

31-14	3D9500-18	CAPACITOR: Same as ref. 31-1	First audio cathode bypass		
31-15	3D9500-18	CAPACITOR: Same as ref. 31-1	First audio cathode bypass		
31-16	3D9500-18	CAPACITOR: Same as ref. 31-1	Driver filament bypass		
31-17	3D9500-18	CAPACITOR: Same as ref. 31-1	Driver filament bypass		
31-18	3D9500-18	CAPACITOR: Same as ref. 31-1	Driver filament bypass		
31-19	3D9500-18	CAPACITOR: Same as ref. 31-1	Driver filament bypass		
31-20	3D9500-18	CAPACITOR: Same as ref. 31-1	Modulator filament bypass		
31-21	3D9500-18	CAPACITOR: Same as ref. 31-1	Modulator filament bypass		
31-22	3D9500-18	CAPACITOR: Same as ref. 31-1	Modulator filament bypass		
31-23	3D9500-18	CAPACITOR: Same as ref. 31-1	Modulator filament bypass		
31-24	3D9500-18	CAPACITOR: Same as ref. 31-1	Input r-f bypass		
31-25	3D9500-18	CAPACITOR: Same as ref. 31-1	Input r-f bypass		
31-26	3D9500-18	CAPACITOR: Same as ref. 31-1	Input r-f bypass		
31-27	3D9500-18	CAPACITOR: Same as ref. 31-1	Input r-f bypass		
31-28	3D9500-18	CAPACITOR: Same as ref. 31-1	Input r-f bypass		
31-29	3D9500-18	CAPACITOR: Same as ref. 31-1	Input r-f bypass		
32-1	3K2010121	CAPACITOR: Fixed; 100 mmf ±10%; 500v dcw; 1000v dct; type 1468	First audio grid r-f bypass	Aerovox	A104591-1
32-2	3K2010121	CAPACITOR: Same as ref. 32-1	First audio grid r-f bypass		
33-1	3DA2-77	CAPACITOR: Fixed; mica; .002 mfd; +14%; —6%; 500v dcw; 1000v dct; Cornell-Dubilier type 1WL; Aerovox type 1467	First audio grid r-f bypass	Aerovox, Cornell-Dubilier	A104614-1
33-2	3DA2-77	CAPACITOR: Same as ref. 33-1	First audio grid r-f bypass		
34	3DA20-37	CAPACITOR: Fixed; mica; .02 mfd; ±10%; 1000v dct; type 1650	Audio oscillator grid blocking	Aerovox	A104195-1
35	3DA4.500	CAPACITOR: Fixed; mica; .0045 mfd; ±2%, 1000v dct; type 1650	Audio oscillator tuning	Aerovox	A104195-3

Reference Symbol	*Army Stock Number Navy Stock Number British Ref. Number*	*Name of Part and Description*	*Function*	*Mfr. and Desig. or AWS Type*	*Bendix Drawing No.*
36-1	3DB25-13	CAPACITOR: Fixed dry electrolytic; 25 mfd; +100%, −10%	Relay supply filter	Aerovox	A104198-1
36-2	3DB525-13	CAPACITOR: Same as ref. 36-1	Relay supply filter		
37	3DB2.6020-	CAPACITOR: Fixed; 2 mfd; 600v dcw; type TJL-6020	Input blocking microphone transmitter	Cornell-Dubilier	C58338-3
38-1	3DB4-40	CAPACITOR: Fixed; 4 mfd; 600v dcw; type TJL 6040	First audio plate bypass	Cornell-Dubilier	C58338-4
38-2	3DB4-40	CAPACITOR: Same as ref. 38-1	Driver plate bypass		
39	3D157	CAPACITOR: Fixed; mica; .02 mfd; +14% −6%; 600v dcw; 1000v dct; No. CA-157	Meter bypass	Cornell-Dubilier	A104604
40	4C4839E	JACK: Microphone; 3-conductor; open 2 circuits when plug inserted; W.E. SK3249D	Microphone jack	Stromberg-Carlson, Western Electric	A104574-1
41	2Z5542	JACK: Microphone; 3-conductor; open two circuits when plug inserted; W.E. Type 239A; Stromberg-Carlson type SK3249F	Microphone jack	Stromberg-Carlson, Western Electric	A104574-2
42	2Z7675-3	RELAY: Quick acting; No. 504-5-1	Keying relay	Stromberg-Carlson	C58361
43	3C336-8	COIL: Reactor; 30 henries; 870 ohms; .025 amp d-c	First audio plate supply filter	Stromberg-Carlson	A27098
44	3F920-7.1	METER: 0-200 milliamperes d-c	Modulator cathode	Weston, G.E., Westinghouse	A104194-3
45-1	3Z6020-36	RESISTOR: Fixed; metallized; 180 ohm; ±10%; ½w; type BT½ (Alternate 200 ohm ±10%; ½w; ASA 3RC21BE201J)	Local microphone limiting resistor	IRC	A104572-201
45-2	3Z6020-36	RESISTOR: Same as ref. 45-1	Local microphone limiting resistor		
46-1	3Z4529	RESISTOR: Fixed; metallized; 10,000 ohms; ±10%; ½w BT-½ (alternate 10,000 ohms; ±10%; ASA 3RC21BF103K)	First audio grid parasitic suppressor	IRC	A104572-103

46-2	3Z4529	**RESISTOR**: Same as ref. 46-1	First audio grid parasitic suppressor		
47-1	3Z4531	**RESISTOR**: Fixed; metallized; 50,000 ohms; ±10%; ½w; BT-½ (alternate 47,000 ohms; ±10%; ½w; ASA 3RC21BF473K)	Second audio loading	IRC	A104572-503
47-2	3Z4531	**RESISTOR**: Same as ref. 47-1	Second audio loading		
48	3Z4534	**RESISTOR**: Fixed; metallized; 1 megohm; ±10%; ½w; BT-½ (alternate 1 megohm; ±10%; ½w; ASA 3RC21BF105K)	Audio oscillator grid leak	IRC	A104572-105
49	3Z6650-49	**RESISTOR**: Fixed; wirewound; metallized; 50,000 ohm; ±5%; 2w; BT-2 or BW-2 (alternate 51,000 ohm; ±5%; 2w; AWS 3RC41BF513J)	Audio oscillator series plate dropping	IRC	A105162-503
50	3Z6050-10	**RESISTOR**: Fixed; metallized; 500 ohm; ±5%; 2w; BT-2; voltage regulating equalizing; conditionally interchangeable with 3RC41BF511J	First audio cathode bias	IRC	A104612-501
51	3Z6032A5-1	**RESISTOR**: Fixed; 325 ohm; ±5%; 18w; clip type; type E, grade 1, class 1	Second audio cathode bias	Hardwick-Hindle	A104573-2
52	2Z7268.17	**POTENTIOMETER**: Dual unit; 600 ohms per section; type CS.	Audio oscillator volume control	IRC	A104577-2
53	2Z7284-7	**POTENTIOMETER**: Dual unit; 15,000 ohms per section; ±10%; type CS	Volume control	IRC	A104577-1
54	3H4856-1	**RECTIFIER**: Selenium; half wave; output 5v d-c .05a	Keying relay power supply	Int. Tel.	A104500
55	3Z8650	**SWITCH**: Key; one way locking; six sets make and break contacts; type #170A	Remote-local switch	Stromberg-Carlson	A104575
56	2Z9881	**TRANSFORMER**: Microphone; pri tapped 100 to 600 to sec 30,000 ohms; pri .040 amp d-c	Microphone input	Bendix	A103006
57	2Z9636.3	**TRANSFORMER**: Interstage; 40,000 ohms pri to 100,000 ohm sec.	Interstage trans.	Bendix	A103008
58	2Z9633.5	**TRANSFORMER**: Driver, 32,000 to 10,000 ohms	Driver Transformer	Bendix	A103010
59	2Z9634.8	**TRANSFORMER**: Modulation; 1500 ohms to 5,700 ohms; turns ratio 1.63 to 1	Modulation transformer	Bendix	A10300

Reference Symbol	*Army Stock Number Navy Stock Number British Ref. Number*	*Name of Part and Description*	*Function*	*Mfr. and Desig. or AWS Type*	*Bendix Drawing No.*
60	2Z9600.3	**TRANSFORMER**: Filament; 230v to 6.3v 1.4a; 6.3v 8a; 6.3v 1.3a; 67.5va 50-60 cycle pri.	Filament supply	Bendix	A27086
61	2Z9638	**TRANSFORMER**: Audio oscillator; 250v pri; freq 1020 cycles; turns ratio 1-3 to 2-3; 6-1; turns ratio 1-3 to 4-5 110-1.	Audio oscillator	Bendix	A27096
62-1	2Z8762.2	**SOCKET**: Tube; octal; 8 contacts; type SS8	1st audio tube octal socket	Amphenol	A19168-6
62-2	2Z8762.2	**SOCKET**: Same as ref. 62-1	1st audio tube octal socket		
62-3	2Z8762.2	**SOCKET**: Same as ref. 62-1	Driver tube octal socket		
62-4	2Z8762.2	**SOCKET**: Same as ref. 62-1	Driver tube octal socket		
62-5	2Z8762.2	**SOCKET**: Same as ref. 62-1	Audio oscillator tube octal socket		
63-1	2Z8764.85	**SOCKET**: Tube; type SS4; 4 prong	Modulator tube socket	Amphenol	A18168-1
63-2	2Z8764.85	**SOCKET**: Same as ref. 63-1	Modulator tube socket		
VT-94	2J6J5	**VACUUM TUBE**: Detector; amplifier triode type 6J5	Input voltage amplifier	RCA	
VT-94	2J6J5	**VACUUM TUBE**: Detector; amplifier triode type 6J5	Input voltage amplifier	RCA	
VT-94	2J6J5	**VACUUM TUBE**: Detector; amplifier triode type 6J5	Audio oscillator	RCA	
VT-175	2J1613	**VACUUM TUBE**: RF power amplifier pentode; type 1613	Push-pull driver	RCA	
VT-175	2J1613	**VACUUM TUBE**: RF power amplifier pentode; type 1613	Push-pull driver	RCA	
VT-217	2J811	**VACUUM TUBE**: Transmitting triode type 811	Class B Modulator	RCA	
VT-217	2J811	**VACUUM TUBE**: Transmitting triode type 811	Class B Modulator	RCA	
	3Z3640	**KEY HANDLE**: Black; type 6541	For key switch	Stromberg-Carlson	A106317-1
	3Z12530	**TERMINAL BOARD ASSEMBLY**: 16 terminals	For external connections to unit	Bendix	AA104613-1

MODEL: RADIO TRANSMITTER BC-640-A AND BC-640-B **MAJOR ASSEMBLY: POWER SUPPLY PANEL PN-12-A**

91	3DB10-19	CAPACITOR: Fixed; electrolytic; 10 mfd; 1500v dc; type TJL 15100	High voltage filter	Cornell-Dubilier	C58388-6
92	3DB10-20	CAPACITOR: Fixed; electrolytic; 10 mfd; 600v dc; type TJL 6100	Low voltage filter	Cornell-Dubilier	C58388-5
93-1	3DA100-108	CAPACITOR: Fixed; 0.1 mfd; 600v dcw; type DY 6010	Line bypass	Cornell-Dubilier	A104625
93-2	3DA100-108	CAPACITOR: Same as ref. 93-1	Line bypass	Cornell-Dubilier	A104625
94-1	3C336-4	COIL: Choke; 11 henries; .270 amp d-c; 90 ohm	Filter choke	Bendix	A27094
94-2	3C336-4	COIL: Same as ref. 94-1	Filter choke		
95-1	3Z6580-6	RESISTOR: Fixed; 8,000 ohms; 90 watt; type B, grade 1, class 1.	Bleeder and voltage divider	Hardwick-Hindle	A104573-5
95-2	3Z6580-6	RESISTOR: Same as ref. 95-1	Bleeder and voltage divider	Hardwick-Hindle	A104573-5
96	3Z6615-39	RESISTOR: Fixed; 1500 ohms; 40 watt; clip type; style D, grade 1, class 1	Bleeder and voltage divider	Hardwick-Hindle	A104573-3
97	2Z9600	TRANSFORMER: Filament; pri 230v; sec 5v CT 3a, 5v CT 3a, 5v CT 6a, 4v CT .25a	Filament supply	Bendix	A27090
98	2Z9601.4	TRANSFORMER: Plate; primary 230v; sec 1025v ±2% at 427 ma dc, 4v ±4% at 250 ma	High voltage supply	Bendix	A103004
99-1	2Z8762.3	SOCKET: Tube; 4 contact	Rectifier tube socket	Johnson	A30440
99-2	2Z8762.3	SOCKET: Same as ref. 99-1	Rectifier tube socket		
99-3	2Z8762.3	SOCKET: Same as ref. 99-1	Rectifier tube socket		
99-4	2Z8762.3	SOCKET: Same as ref. 99-1	Rectifier tube socket		
VT-145	2J5Z3	VACUUM TUBE: Full wave rectifier; type 5Z3	High vacuum rectifier	RCA	
VT-145	2J5Z3	VACUUM TUBE: Full wave rectifier; type 5Z3	High vacuum rectifier	RCA	
VT-145	2J5Z3	VACUUM TUBE: Full wave rectifier; type 5Z3	High vacuum rectifier	RCA	
VT-145	2J5Z3	VACUUM TUBE: Full wave rectifier; type 5Z3	High vacuum rectifier	RCA	
	3Z12530	TERMINAL BOARD ASSEMBLY: 16 terminals	For external connections to unit	Bendix	AA104613-1

MODEL: RADIO TRANSMITTER BC-640-A AND BC-640-B **MAJOR ASSEMBLY: POWER SUPPLY PANEL PN-13-A**

Reference Symbol	*Army Stock Number Navy Stock Number British Ref. Number*	*Name of Part and Description*	*Function*	*Mfr. and Desig. or AWS Type*	*Bendix Drawing No.*
111-1	3Z1903-10	FUSE: 10 amp; 250 volt	110/125v a-c input	Bussman	A104542-4
111-2	3Z1903-10	FUSE: Same as ref. 111-1	110/125v a-c input		
112-1	3Z2605.4	FUSE: 5 amp; 250 volt; type 504	220/250v a-c input	Bussman	A104542-1
112-2	3Z2605.4	FUSE: Same as ref. 112-1	220/250v a-c input		
113	3F8300-10	METER: 0-300v a-c; Weston No. 517; Westinghouse No. NA-33	Output voltage indicator	Weston, Westinghouse	A104615
114	2Z5992	LAMP: Pilot; 150v; 6 watt; candelabra; type 56	Power on indicator	Kirkland	A104684
115	2Z5992	PILOT LIGHT ASSEMBLY: Bullseye unit; Cat No. CHR-601; red	Power on indicator	Kirkland	A104684
116	3Z9842.1	SWITCH: 3 pole standard contact; 250v a-c; 15 amp; No. 8337	Power mains switch	Cutler-Hammer	A104675
117	2Z9957-9	TRANSFORMER: 220 to 250v; 50/60 cy; supply 230v 1100 VA to load; type 100R	Output voltage adjustment	G.R. Superior Electric	C58370
	2Z9409-18	TERMINAL BOARD ASSEMBLY: 9 terminals	For external connections to unit-	Bendix	C58368-1
	2Z9957-10	AUTOTRANSFORMER: Transtat; input 110v 50-60 cycles; output 220v 1 KVA	Line voltage step up	Bendix	A103064

MODEL: RADIO TRANSMITTER BC-640-A AND BC-640-B **MAJOR ASSEMBLY: AMPLIFIER PANEL PN-8-A**

121-1	3K3551222	CAPACITOR: Fixed; mica; 5100 mmfd; ±5% 1000v dct; 500v dcw; Aerovox type 1467; Cornell-Dubilier 1WL (alternate .0056 mfd ±5%; 600v dcw; JAN CM35B512J)	Filament bypass	Aerovox, Cornell-Dubilier	A104614-2
121-2	3K3551222	CAPACITOR: Same as ref. 121-1	Filament bypass		
121-3	3K3551222	CAPACITOR: Same as ref. 121-1	Filament bypass		
121-4	3K3551222	CAPACITOR: Same as ref. 121-1	Filament bypass		

122-1	3K2010121	CAPACITOR: Fixed; 100 mmf; ±10%; 500v dcw; type 1468 (alternate .0001 mfd; ±10%; 1000v dct; ASA CM20B101K)	Monitor filament bypass	Aerovox	A104591-1
122-2	3K2010121	CAPACITOR: Same as ref. 122-1	Monitor filament bypass		
122-3	3K2010121	CAPACITOR: Same as ref. 122-1	Monitor cathode bypass		
122-4	3K2010121	CAPACITOR: Same as ref. 122-1	Monitor r-f filter		
122-5	3K2010121	CAPACITOR: Same as ref. 122-1	Monitor r-f filter		
122-6	3K2010121	CAPACITOR: Same as ref. 122-1	Monitor r-f filter		
123-1	3D9001E5	CAPACITOR: Fixed; mica; 1.5 mmf; ±½ mmf: 1000v dct; type 1468	Monitor r-f coupling	Aerovox	A104591-3
123-2	3D9001E5	CAPACITOR: Same as ref. 123-1	Monitor r-f coupling		
124	3DA100-108	CAPACITOR: Fixed; 0.1 mfd; 600v dcw; type DY 6010	Monitor d-c blocking	Cornell-Dubilier	A104625
125	3K5647121	CAPACITOR: Fixed; mica; .00047 mfd; ±10% 5000v dct; (alternate .00047 mfd ±10% 5000v dct; ASA CM56B471K)	R-F amplifier plate bypass	Aerovox	A104195
126-1	3K2047121	CAPACITOR: Fixed; mica; .0005 mfd; ±10% 1000v dct; type 1468 (alternate .00047 mfd; 10% 1000v dct; ASA CM20B471K)	R-F amplifier grid bypass	Aerovox	A104591-2
126-2	3K2047121	CAPACITOR: Same as ref. 126-1	R-F amplifier grid bypass		
127	3DA5-48	CAPACITOR: Fixed; mica; .005 mfd; ±10%; 1000v dct; type 1650 (alternate .0047 mfd; 10%; 1000v dct; ASA CN56B472K)	R-F grid shunt	Aerovox	A104195-5
128	3D9032V	CAPACITOR: Variable; 3.3 mmf min to 32 mmf max	Grid tuning	Cardwell	A105268
129	3D9016V-6	CAPACITOR: Variable; special line tuning; 3 to 16 mfd; cylinder type	Plate tuning	Bendix	L73319 A104631
130	3D9017VE5	CAPACITOR: Variable; 3.5 mmf to 17.5 mmf per section	Antenna tuning	Cardwell	A105331
131a 131b	3D9002V-1	CAPACITOR: Variable; dual; split stator split rotor; 2 mmf to 2.8 mmf per section	Neutralizing	Cardwell	A105269
132-1	3D157	CAPACITOR: Fixed; mica; .02 mfd +14% -6%; 600v dcw; 1000v dct; No. CA-157.	Meter bypass	Cornell-Dubilier	A104604

Reference Symbol	*Army Stock Number Navy Stock Number British Ref. Number*	*Name of Part and Description*	*Function*	*Mfr. and Desig. or AWS Type*	*Bendix Drawing No.*
132-2	3D157	CAPACITOR: Same as ref. 132-1	Meter bypass		
133	2Z5542	JACK: Microphone; 3 conductor; open two circuits when plug inserted	Monitor jack	Stromberg-Carlson	A104574-2
134-1	3F2999-5	INDUCTOR: R-F choke	Plate r-f choke	Bendix	A105375-1
134-2	3F2999-5	INDUCTOR: Same as ref. 134-1	Monitor r-f choke		
134-3	3F2999-5	INDUCTOR: Same as ref. 134-1	Monitor r-f choke		
134-4	3F2999-5	INDUCTOR: Same as ref. 134-1	Monitor r-f choke		
135	3F2999-2	INDUCTOR: Two 7″ sections ¼″ copper tubing; L shape	Grid tank	Bendix	A104635
136	3F2999	INDUCTOR: Two 15″ sections ¼″ copper tubing; L shape	Plate tank	Bendix	A105235
137	3F2999-3	INDUCTOR: For antenna coupling; 7″; U shape	Antenna coupling	Bendix	A105288-1
138	3F2999-4	INDUCTOR: Antenna tuning; ⅛″ 90% bend copper tubing	Antenna tuning	Bendix	A105996-1
139	3F903-7	METER: 0-30 ma d-c; ASA type MR24W 030DCMA (used on BC-640-B only)	Amplifier grid meter	Weston	C62063
139	3F902-7	METER: 0-25 ma d-c; No. 506 (used on BC-640-A only)	Amplifier grid meter	Weston	A104194-1
140	3F910-3	METER: 0-100 ma d-c; No. 506	Amplifier cathode meter	Weston	A104194-2
141-1	3Z6050-10	RESISTOR: Fixed; metallized; 500 ohm ±5% 2w; BT-2; voltage regulator equalizing; conditionally interchangeable with 3RC41BE511J (alternate 510 ohm; ±5%; 2w; ASA 3RC41BF511J)	Monitor load parasitic suppressor	IRC	A104162-501
141-2	3Z6050-10	RESISTOR: Same as ref. 141-1	R-F plate choke shunt parasitic suppressor		
142	3Z6500-67	RESISTOR: Fixed; wirewound or metallized; 5000 ohm; ±10%; type BT-2 or BW-2 (alternate 5100 ohm; ±5% 2w; ASA 3RC41BF511J)	Monitor jack isolating res.	IRC	A105162-502

143-1	3Z6005-30	RESISTOR: Fixed; metallized; 50 ohm; ±5% 2w; type BT-2 or BW-2; (alternate 51 ohm; ±5% 2w; ASA 3RC41BF510J)	Cathode meter shunt	IRC	A105162-500
143-2	3Z6005-30	RESISTOR: Same as ref. 143-1	Cathode meter shunt		
143-3	3Z6005-30	RESISTOR: Same as ref. 143-1	Grid meter shunt		
143-4	3Z6005-30	RESISTOR: Same as ref. 143-1	Grid meter shunt		
143-5	3Z6005-30	RESISTOR: Same as ref. 143-1	Monitor meter shunt		
144-1	3Z6614-1	RESISTOR: Fixed; metalized or wire wound; 14,000 ohm; ±5%; 2w; type BT-2 or BW-2 (alternate 15000 ohm; ±5%; 2w; ASA 3RC41BF155J)	Grid leak	IRC	A105162-143
144-2	3Z6614-1	RESISTOR: Same as ref. 144-1	Grid leak		
144-3	3Z6614-1	RESISTOR: Same as ref. 144-1	Grid leak		
144-4	3A6614-1	RESISTOR: Same as ref. 144-1	Grid leak		
145-1	3RC41BE302J	RESISTOR: Fixed; metallized or wire wound; 3000 ohms; ±5%; 2w; type BT-2 or BW-2 (alternate 3000 ohms; ±5%; 2w; ASA 3RC41BE302J)	Grid leak	IRC	A105162-302
145-2	3RC41BE302J	RESISTOR: Same as ref. 145-1	Grid leak		
146	2Z9600.7	TRANSFORMER: Filament; pri 230v 60 cycle 40 VA; sec 6.3/3.15 v, ±3%, 3 amp; 6.3/3.15 v, ±3% 3 amp; CT. 6.3v ±2% .32 amp.	Filament power supply	Bendix	A27088
147-1	2Z8674.85	SOCKET: Tube; 4 prong	R-F amplifier socket	Amphenol	A18168-1
147-2	2Z8674.85	SOCKET: Same as ref. 147-1	R-F amplifier socket		
148	2Z8762.2	SOCKET: Octal; 8 contacts; type SS8	Monitor socket	Amphenol	A18168-6
149	3Z9825-17	SWITCH: Wafer; SP 3 position	Grid meter switch	Oak	A105371
150	3Z9825-16	SWITCH: Wafer; SP 2 position	Cathode meter switch	Oak	A105370
151-1	3Z5991-41	RESISTOR: Fixed; 1.333 ohm; ±1%; 15w; type 180	Meter shunt	Shallcross	A112295-1
151-2	3Z5991-41	RESISTOR: Same as ref. 151-1	Meter shunt		

MODEL: RADIO TRANSMITTER BC-640-A AND BC-640-B **MAJOR ASSEMBLY: AMPLIFIER PANEL PN-8-A**

Reference Symbol	*Army Stock Number Navy Stock Number British Ref. Number*	*Name of Part and Description*	*Function*	*Mfr. and Desig. or AWS Type*	*Bendix Drawing No.*
152	3Z5992-27	RESISTOR: Fixed; wirewound; 2.8 ohms; ±1%; .5w; type 180	Meter series multiplier	Shallcross	A112295-3
153	3Z5985-5	RESISTOR: Fixed; wirewound; .57 ohms; ±1%; .5w; type 180	Meter shunt	Shallcross	A112295-4
154	3Z9825-65.41	SWITCH: DP wafer; two bank; five position	M-A current meter switch	Oak	C60880
VT-204	2J3C24	VACUUM TUBE: VT-204; transmitting type triode; type JAN-3C24	Amplifier	H & K	
VT-204	2J3C24	VACUUM TUBE: VT-204; transmitting type triode; type JAN-3C24	Amplifier	H & K	
VT-94	2J6J5	VACUUM TUBE: VT-94; detector amplifier triode; type 6J5	Monitor rectifier	RCA	
	2Z5822-6	KNOB: Black; bakelite	Neutralizing condenser knob	Kurz-Kasch	A105988
	2Z7112.29	LINK ASSEMBLY: Black phenolic plug with shorted link	Link and high voltage supply	Bendix	C58654
	2Z3764.16	DIAL COLLAR AND SHAFT ASSEMBLY: Dial nickel-silver 2″ dia	Neutralizing condenser dial	Kurz-Kasch	A105281
	2Z5844	KNOB: Pointer with line	Meter selector switch knob	Insuline Corp.	A2003
	2Z3764.1	DIAL TUNING ASSEMBLY: Dual; vernier type	Tuning dials	General Rad Co.	A105237
	3Z12530	TERMINAL BOARD ASSEMBLY: 16 terminals	For external connections to unit	Bendix	AA104613

MODEL: RADIO TRANSMITTER BC-640-A AND BC-640-B **MAJOR ASSEMBLY: OSCILLATOR PANEL PN-9-A**

158	3Z6050-10	RESISTOR: Fixed; metalized; 500 ohm; ±5%; 2w; type BT-2; voltage regulator equalizing; conditionally interchangeable with 3RC41BE511J (alternate 510 ohm; ±5%; 2w; ASA 3RC41BF510J)	IPA choke shunt parasitic suppressor	IRC	A104162-501

159	3C336-15.	COIL ASSEMBLY: Choke; r-f	IPA plate choke	Bendix	A105376-2
160	2Z8761-9.3	SOCKET: Crystal	Crystal socket	Bendix	C58396-1
161-1	3K3551222	CAPACITOR: Fixed; mica; .005 mfd; ±10%; 1000v dct; 500v dcw; Aerovox type 1467; Cornell-Dubilier type 1WL (alternate. 0051 mfd; ±5%; 500v dcw; JAN CM35B512J)	Oscillator cathode bypass	Aerovox, Cornell-Dubilier	A104614-2
161-2	3K3551222	CAPACITOR: Same as ref. 161-1	Oscillator filament bypass		
161-3	3K3551222	CAPACITOR: Same as ref. 161-1	Oscillator filament bypass		
161-4	3K3551222	CAPACITOR: Same as ref. 161-1	Oscillator screen bypass		
161-5	3K3551222	CAPACITOR: Same as ref. 161-1	First tripler cathode bypass		
161-6	3K3551222	CAPACITOR: Same as ref. 161-1	First tripler filament bypass		
161-7	3K3551222	CAPACITOR: Same as ref. 161-1	First tripler filament bypass		
161-8	3K3551222	CAPACITOR: Same as ref. 161-1	First tripler screen bypass		
161-9	3K3551222	CAPACITOR: Same as ref. 161-1	Doubler filament bypass		
161-10	3K3551222	CAPACITOR: Same as ref. 161-1	Doubler filament bypass		
162 1	3DA5-48	CAPACITOR: Fixed; mica; .005 mfd; ±10%; 1000v dct; type 1650 (alternate .0047 mfd; ±10%; 1000v dct; AWS CM56B472K)	Oscillator plate bypass	Aerovox	A104195-5
162-2	3DA5-48	CAPACITOR: Same as ref. 162-1	Doubler grid leak bypass		
162-3	3DA5-48	CAPACITOR: Same as ref. 162-1	Doubler plate bypass		
163-1	3D9009V	CAPACITOR: Variable; 9 to 106 mmf	Oscillator plate tuning	Johnson	A105240
163-2	3D9009V	CAPACITOR: Same as ref. 163-1	First tripler plate tuning		
164	3DA2-78	CAPACITOR: Fixed; mica; .002 mfd; ±2%; 1000v dct; 600v dcw; type 1650.	Oscillator plate tank padding	Aerovox	A104195-8
165	3D9050-58	CAPACITOR: Fixed; 50 mmf; ±10%; 600v dcw; type 1650 (alternate 47 mmf ±10%; 1000v dct; ASA CM56B470K)	First tripler grid blocking	Aerovox	A104195-4

Reference Symbol	*Army Stock Number Navy Stock Number British Ref. Number*	*Name of Part and Description*	*Function*	*Mfr. and Desig. or AWS Type*	*Bendix Drawing No.*
166-1	3DA2-79	CAPACITOR: Fixed; mica; .002 mfd; ±10%; 1500v dcw; type 1651	First tripler plate bypass	Aerovox	A104195-7
166-2	3DA2-79	CAPACITOR: Same as ref. 166-1	Second tripler plate bypass		
166-3	3DA2-79	CAPACITOR: Same as ref. 166-1	Doubler grid blocking		
167	3D9002VE8	CAPACITOR: Variable; 2.8 to 8.5 mmf;	First tripler plate trimmer	Cardwell	A105262
168-1	3D9500-68	CAPACITOR: Fixed; mica; .0005 mfd; ±10%; 2500v dcw; 5000v dct; type 1652 (alternate .00047 mfd; ±10%; 5000v dct; ASA CM56B471K)	Second tripler grid blocking	Aerovox	A104195-6
168-2	3D9500-68	CAPACITOR: Same as ref. 168-1	IPA grid blocking		
168-3	3D9500-68	CAPACITOR: Same as ref. 168-1	IPA plate bypass		
169-1	3DA2-77	CAPACITOR: Fixed; mica; .002 mfd; +14%; −6%; 500v dcw; 1000v dct; Aerovox type 1467; Cornell-Dubilier type 1WL (alternate .0022 mfd; ±10%; 250v dcw; ASA CM30B222K)	Second tripler grid bypass	Aerovox, Cornell-Dubilier	A104614-1
169-2	3DA2-77	CAPACITOR: Same as ref. 169-1	Second tripler filament bypass		
169-3	3DA2-77	CAPACITOR: Same as ref. 169-1	Second tripler filament bypass		
169-4	3DA2-77	CAPACITOR: Same as ref. 169-1	IPA filament bypass		
169-5	3DA2-77	CAPACITOR: Same as ref. 169-1	IPA filament bypass		
169-6	3DA2-77	CAPACITOR: Same as ref. 169-1	IPA grid leak bypass		
170	3D9007V	CAPACITOR: Variable; 7 to 48 mmf	Second tripler tuning	Johnson	A105239
171	3D9002VE5	CAPACITOR: Variable; dual; 2.5 to 35 mmf per section	Doubler plate tuning	Cardwell	A105623

172	3D9005V-1	CAPACITOR: Variable; dual; 5-27 mmf per section	IPA plate tuning	Cardwell	A105241
173	3D9002VE9	CAPACITOR: Variable; 1.9 to 3 mmf	IPA Neutralizing	Cardwell	A105624
174-1	3D157	CAPACITOR: Fixed; mica; .02 mfd; +14%; -6%; 600v dcw; 1000v dct; No. CA-157	Cathode meter bypass	Cornell-Dubilier	A104604
174-2	3D157	CAPACITOR: Same as ref. 174-1	IPA grid meter bypass		
175	3D9015-7	CAPACITOR: Fixed; ceramicon; 15 mmf ±1 mmf; 500v dcw; type NPOL	Crystal bypass	Erie	A18182-17
176	3Z9825-18	SWITCH: Wafer; SP; five position	Cathode meter selector switch	Oak	A105946
177	3F2999-5	INDUCTOR: R-F choke	IPA plate choke	Bendix	A105375-1
178	3C2505-2	COIL: #20 scc; 8.67 uh; 31 turns	Oscillator tank	Bendix	A105373-1
179	3C2505-3	COIL: #16 AWG; .885 uh; 7 turns	First tripler tank	Bendix	A105376-1
180	3C336-5	COIL: R-F choke; 25.7 uh; 81 turns	Second tripler grid choke	Bendix	A105376-1
181	3C2505	COIL: ⅛" copper tubing; 3 turns	Second tripler plate tank	Bendix	A105372-1
182	3C336-14	COIL: #28 dcc; r-f choke, 30 turns	Second tripler plate choke	Bendix	A105377-1
183	3C336-7	COIL: R-F choke; .782 uh; 30 turns	Doubler plate choke	Bendix	A105378-1
184	3C2505-1	COIL: ⅛" copper tubing; 4 turns	Doubler tank	Bendix	A103752
185	3F2999-1	INDUCTOR: ¼" copper tubing; transmission line	IPA tank	Stromberg-Carlson	A105261
186	3F902-7	METER: 0-25 ma d-c; Weston No. 506	IPA grid meter	Weston, G. E. Westinghouse	A104194-1
187	3F910-3	METER: 0-100 ma d-c; Weston No. 506	Cathode current meter	Weston, G. E., Westinghouse	A104194-2
188	3RC41BE104J	RESISTOR: Fixed; metallized; 100,000 ohms; ±5%; 2w; type BT-2 or BW-2	Oscillator grid leak	IRC	A105162-104
189-1	3Z6005-30	RESISTOR: Fixed; metallized; 50 ohms; ±5%; 2w; type BT-2 or BW-2 (alternate 51 ohms; ±5%; 2w; ASA 3RC41BF510J)	Oscillator meter shunt	IRC	A105162-500
189-2	3Z6005-30	RESISTOR: Same as ref. 189-1	First tripler meter shunt		

Reference Symbol	*Army Stock Number* *Navy Stock Number* *British Ref. Number*	*Name of Part and Description*	*Function*	*Mfr. and Desig. or AWS Type*	*Bendix Drawing No.*
189-3	3Z6005-30	RESISTOR: Same as ref. 189-1	Second tripler meter shunt		
189-4	3Z6005-30	RESISTOR: Same as ref. 189-1	Doubler meter shunt		
189-5	3Z6005-30	RESISTOR: Same as ref. 189-1	IPA meter shunt		
189-6	3Z6005-30	RESISTOR: Same as ref. 189-1	Grid current meter shunt		
190-1	3Z6650-49	RESISTOR: Fixed; metallized; 50,000 ohms; ±5%; 2w; type BT-2 or BW-2 (Alternate 51,000 ohms; ±5%; 2w; 3RC41BF513J)	Oscillator screen dropping	IRC	A105162-503
190-2	3Z6650-49	RESISTOR: Same as ref. 190-1	First tripler screen dropping		
191-1	3Z6625-28	RESISTOR: Fixed; metallized; 25,000 ohms; ±5%; 2w; type BT-2 (alternate 24,000 ohms; ±5%; 2w; ASA 3RC41BF243J)	First tripler grid leak	IRC	A105162-253
191-2	3Z6625-28	RESISTOR: Same as ref. 191-1	Second tripler grid leak		
192-1	3Z6100-65	RESISTOR: Fixed; 1000 ohms; ±5%; 15w; type F grade 1, class 1	First tripler cathode bias	Hardwick-Hindle	A104573-6
192-2	3Z6100-65	RESISTOR: Same as ref. 192-1	Second tripler cathode bias		
193-1	3Z6575-25	RESISTOR: Fixed; wirewound or metallized; 7500 ohms; ±5%; 2w; type BW-2 or BT-2; (alternate 7500 ohms ±5%; 2w; ASA 3RC41BF752J)	Doubler grid leak	IRC	A105162-752
193-2	3Z6575-25	RESISTOR: Same as ref. 193-1	Doubler grid leak		
194-1	3Z6500-67	RESISTOR: Fixed; wirewound or metallized; 5000 ohms; ±10%; type BT-2 or BW-2 (alternate 5100 ohms; ±5%; 2w; ASA 3RC41BF512J)	IPA grid leak	IRC	A105162-502
194-2	3Z6500-67	RESISTOR: Same as ref. 194-1	IPA grid leak		

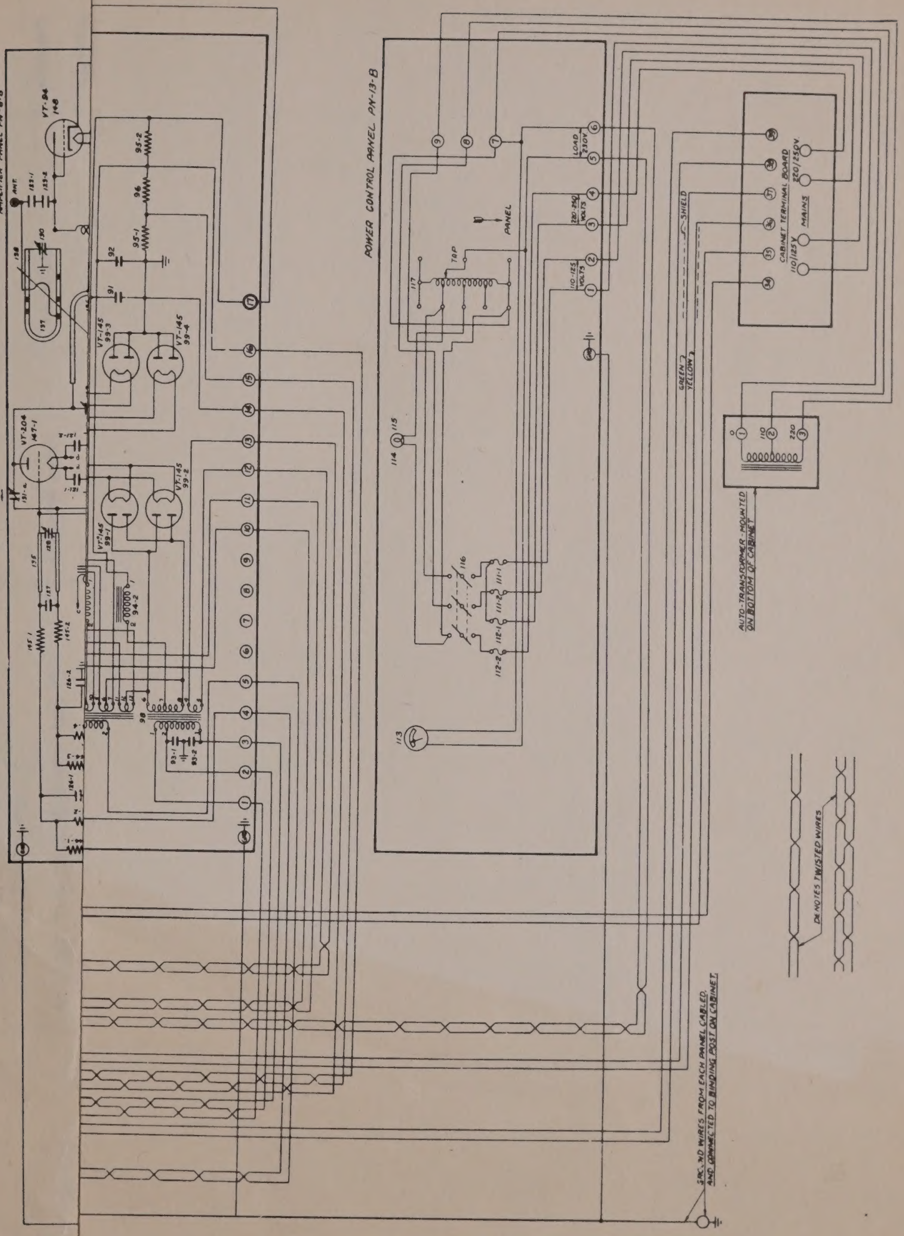

AMPLIFIER PANEL PN-8-B
ANT.
VT-94 148
VT-145 99-3
VT-145 99-4
VT-204 147-1
VT-145 99-1
VT-145 99-2
94-2
98
93-1
93-2
95-1
95-2
96
91
92
POWER CONTROL PANEL PN-13-B
LOAD 230V
220-250 VOLTS
110-125 VOLTS
PANEL
TAP
117
116
111-1
111-2
112-1
112-2
113
114
115
SHIELD
GREEN
YELLOW
CABINET TERMINAL BOARD
MAINS
110/125V
220/250V
110
220
AUTO-TRANSFORMER - MOUNTED ON BOTTOM OF CABINET
DENOTES TWISTED WIRES
GROUND WIRES FROM EACH PANEL CABLED AND CONNECTED TO BINDING POST ON CABINET

Figure 62 — Radio Transmitter BC-640-B, Schematic Diagram

Reference Symbol	Army Stock Number Navy Stock Number British Ref. Number	Name of Part and Description	Function	Mfr. and Desig. or AWS Type	Bendix Drawing No.
189-3	3Z6005-30	**RESISTOR:** Same as ref. 189-1	Second tripler meter shunt		
189-4	3Z6005-30	**RESISTOR:** Same as ref. 189-1	Doubler meter shunt		
189-5	3Z6005-30	**RESISTOR:** Same as ref. 189-1	IPA meter shunt		
189-6	3Z6005-30	**RESISTOR:** Same as ref. 189-1	Grid current meter shunt		
190-1	3Z6650-49	RESISTOR: Fixed; metallized; 50,000 ohms; ±5%; 2w; type BT-2 or BW-2 (Alternate 51,000 ohms; ±5%; 2w; 3RC41BF513J)	Oscillator screen dropping	IRC	A105162-503
190-2	3Z6650-49	RESISTOR: Same as ref. 190-1	First tripler screen dropping		
191-1	3Z6625-28	RESISTOR: Fixed; metallized; 25,000 ohms; ±5%; 2w; type BT-2 (alternate 24,000 ohms; ±5%; 2w; ASA 3RC41BF243J)	First tripler grid leak	IRC	A105162-253
191-2	3Z6625-28	**RESISTOR:** Same as ref. 191-1	Second tripler grid leak		
192-1	3Z6100-65	**RESISTOR:** Fixed; 1000 ohms; ±5%; 15w; type F grade 1, class 1	First tripler cathode bias	Hardwick-Hindle	A104573-6
192-2	3Z6100-65	**RESISTOR:** Same as ref. 192-1	Second tripler cathode bias		
193-1	3Z6575-25	**RESISTOR:** Fixed; wirewound or metallized; 7500 ohms; ±5%; 2w; type BW-2 or BT-2; (alternate 7500 ohms ±5%; 2w; ASA 3RC41BF752J)	Doubler grid leak	IRC	A105162-752
193-2	3Z6575-25	RESISTOR: Same as ref. 193-1	Doubler grid leak		
194-1	3Z6500-67	RESISTOR: Fixed; wirewound or metallized; 5000 ohms; ±10%; type BT-2 or BW-2 (alternate 5100 ohms; ±5%; 2w; ASA 3RC41BF512J)	IPA grid leak	IRC	A105162-502
194-2	3Z6500-67	**RESISTOR:** Same as ref. 194-1	IPA grid leak		

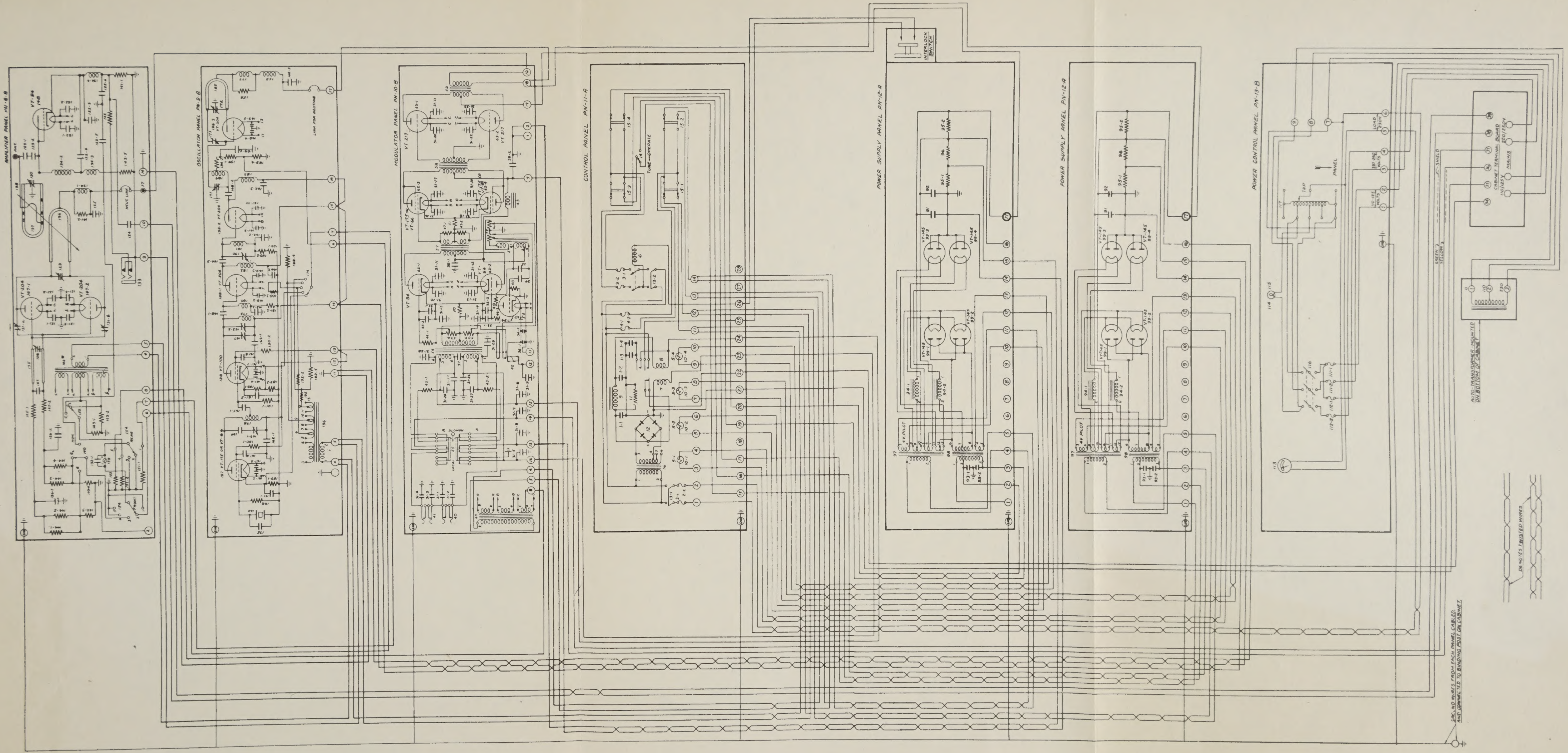

AMPLIFIER PANEL PN-8-B
OSCILLATOR PANEL PN-9-B
MODULATOR PANEL PN-10-B
CONTROL PANEL PN-11-A
POWER SUPPLY PANEL PN-12-A
POWER SUPPLY PANEL PN-12-A
POWER CONTROL PANEL PN-13-B
INTERLOCK SWITCH
TUNE—OPERATE
AUTO-TRANSFORMER MOUNTED ON BOTTOM OF CABINET
DENOTES TWISTED WIRES
GND WIRES FROM EACH PANEL CABLED AND CONNECTED TO BINDING POST ON CABINET

Figure 62 — Radio Transmitter BC-640-B, Schematic Diagram

195	3Z6012A5-1	RESISTOR: fixed; clip type; 125 ohms; ±5%; 15w; style F grade 1, class 1	IPA cathode bias	Hardwick-Hindle	A104573-1
196	2Z9600.5	TRANSFORMER: Filament; 230v pri; 50-60 cycles; sec 6.3/3.15v 3 amps CT; 6.3/3.15v 3 amps CT; 6.3v 1.6 amp	Filament supply	Bendix	A27092
197	2Z8762.2	SOCKET: Tube; octal; 8 contacts; type SS-8	Oscillator socket	Amphenol	A18168-6
198	2Z8659-2	SOCKET: Tube; 5 contacts; type SS5	First tripler socket	Amphenol	A18168-A
199-1	2Z8674.22	SOCKET: Tube; 4 prong, type SS4	Second tripler socket	Amphenol	A18168-1
199-2	2Z8674.22	SOCKET: Same as ref. 199-1	Doubler socket		
199-3	2Z8674.22	SOCKET: Same as ref. 199-1	IPA socket		
VT-175	2J1613	VACUUM TUBE: Type 1613	Oscillator	RCA	
VT-100	2J807	VACUUM TUBE: Type 807	First tripler	RCA	
VT-204	2J3C24	VACUUM TUBE: Type JAN-3C24	Second tripler	H & K	
VT-204	2J3C24	VACUUM TUBE: Type JAN-3C24	Doubler	H & K	
VT-204	2J3C24	VACUUM TUBE: Type JAN-3C24	Amplifier	H & K	
	2Z5844	KNOB: Pointer with line; No. 1274	Meter switch, neutralizing condenser, trimmer capacitor knobs	Insuline Corp.	A2003
	2Z3764.1	DIAL TUNING ASSEMBLY: Dual; vernier type	Tuning dials	G. R. Co.	A105237
	2Z7112.29	PLUG: Black phenolic plug; shorted link	Link and high voltage supply	Bendix	AC58654B
	3Z12530	TERMINAL BOARD ASSEMBLY: 16 terminals	For external connections to unit	Bendix	AA104613-1

SECTION VIII
DRAWINGS

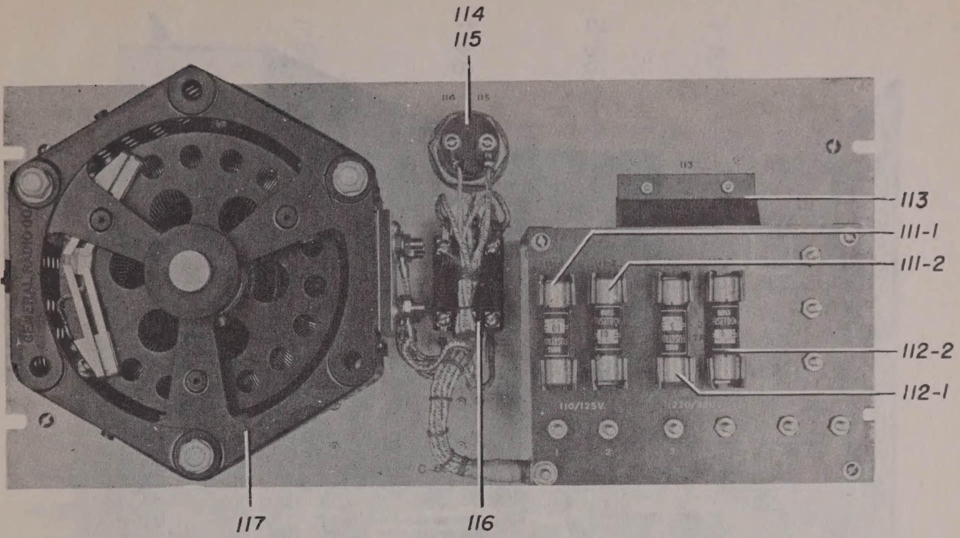

114
115
113
111-1
111-2
112-2
112-1
117
116

Figure 25 — Power Control Panel PN-13-A, and PN-13-B, Rear View

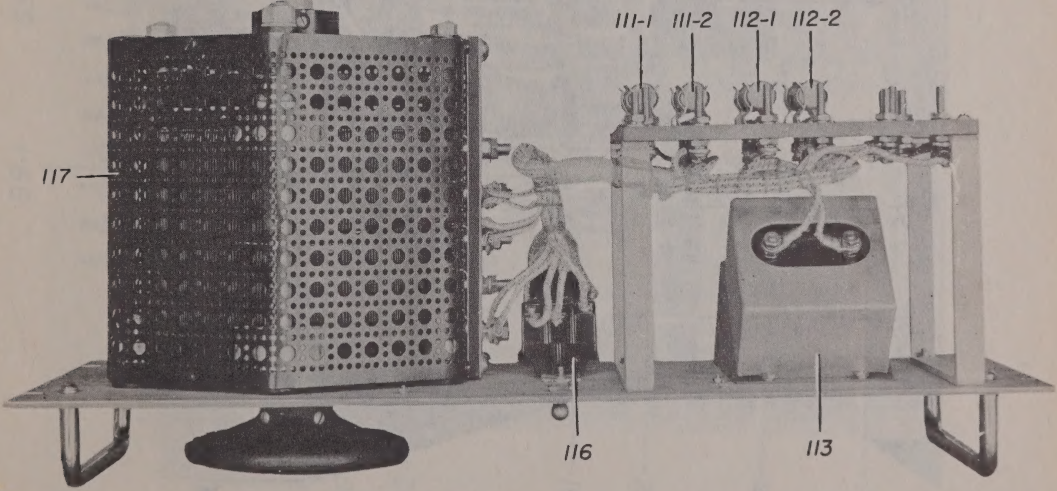

111-1
111-2
112-1
112-2
117
116
113

Figure 26 — Power Control Panel PN-13-A, and PN-13-B, Bottom View

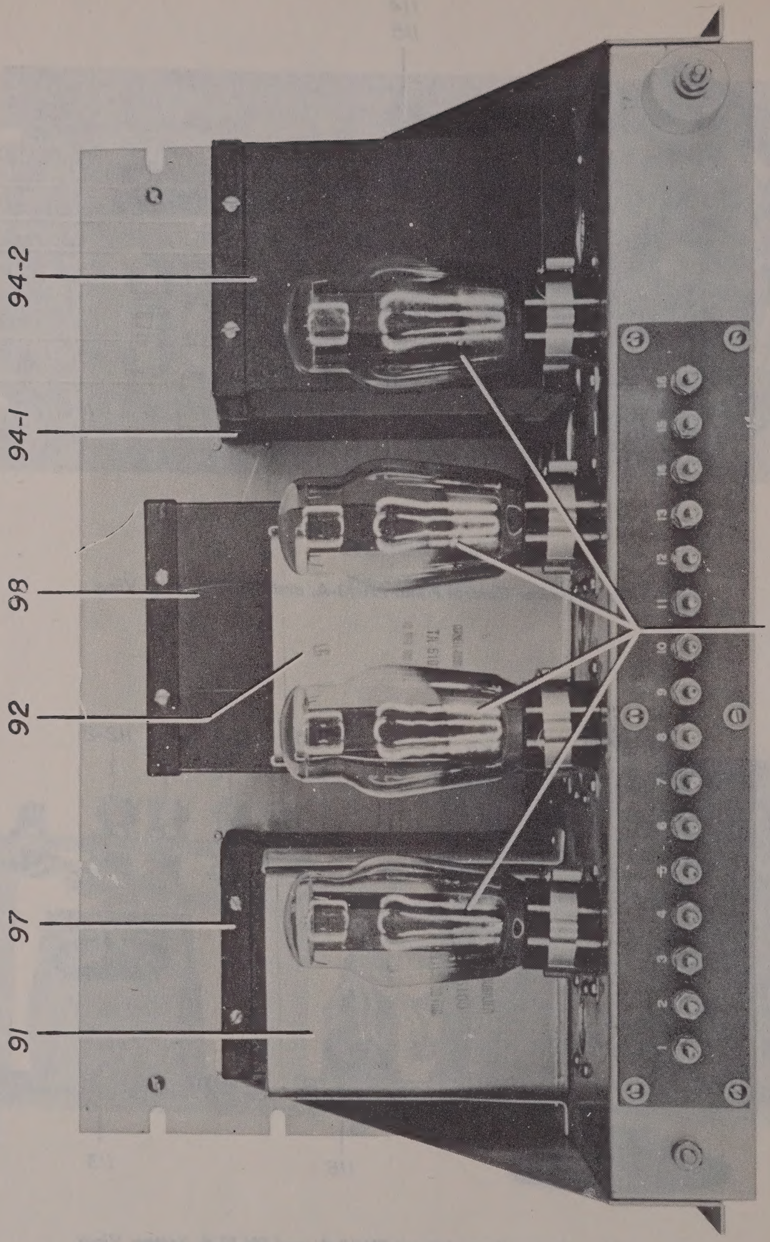

94-2
94-1
98
92
97
91
VT-145

Figure 27 — Power Supply Panel PN-12-A, Rear View

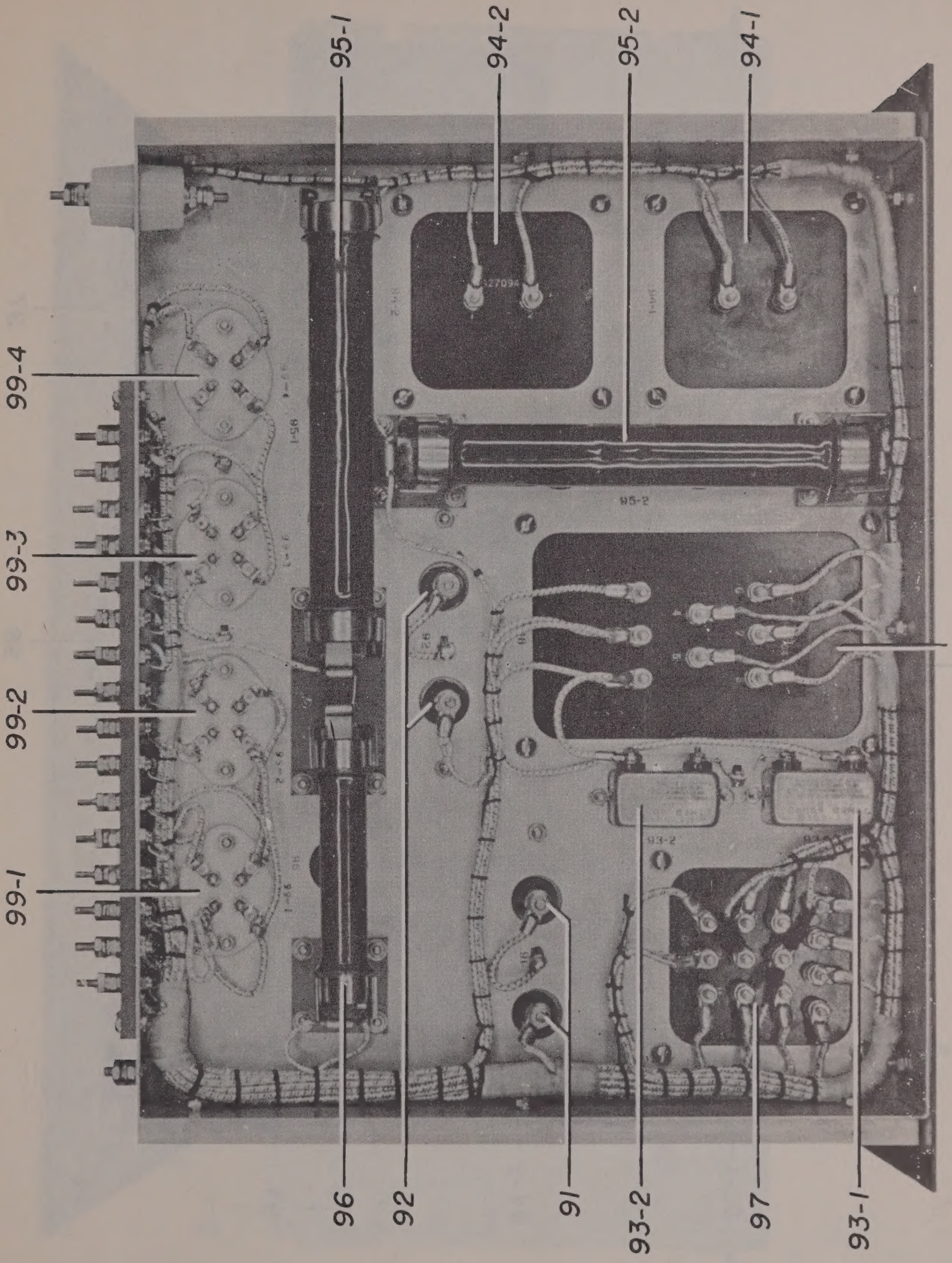

95-1
94-2
95-2
94-1
99-4
99-3
99-2
99-1
96
92
91
93-2
97
93-1

Figure 28 — Power Supply Panel PN-12-A, Bottom View

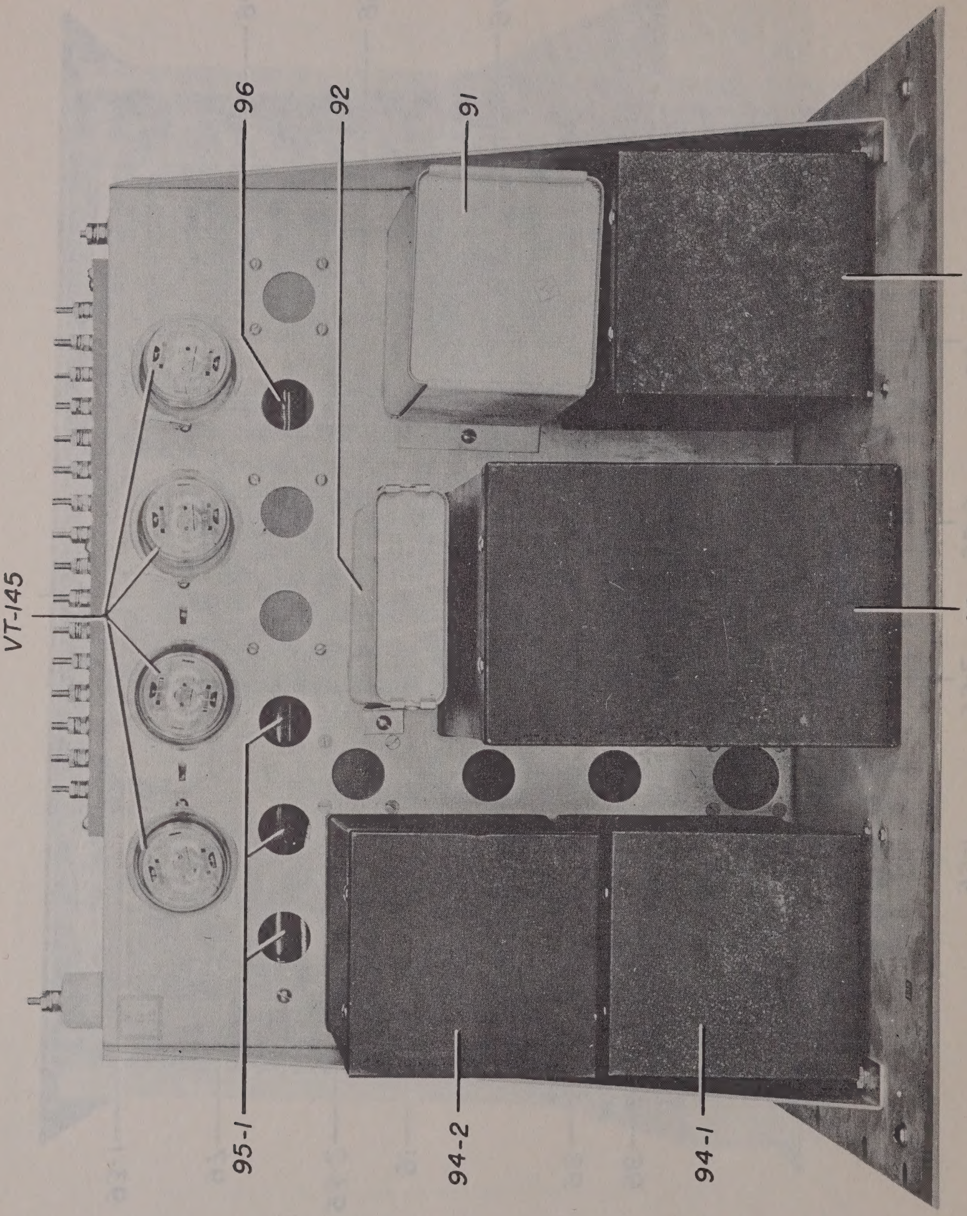

VT-145
96
92
91
97
98
95-1
94-2
94-1

Figure 29 — Power Supply Panel PN-12-A, Top View

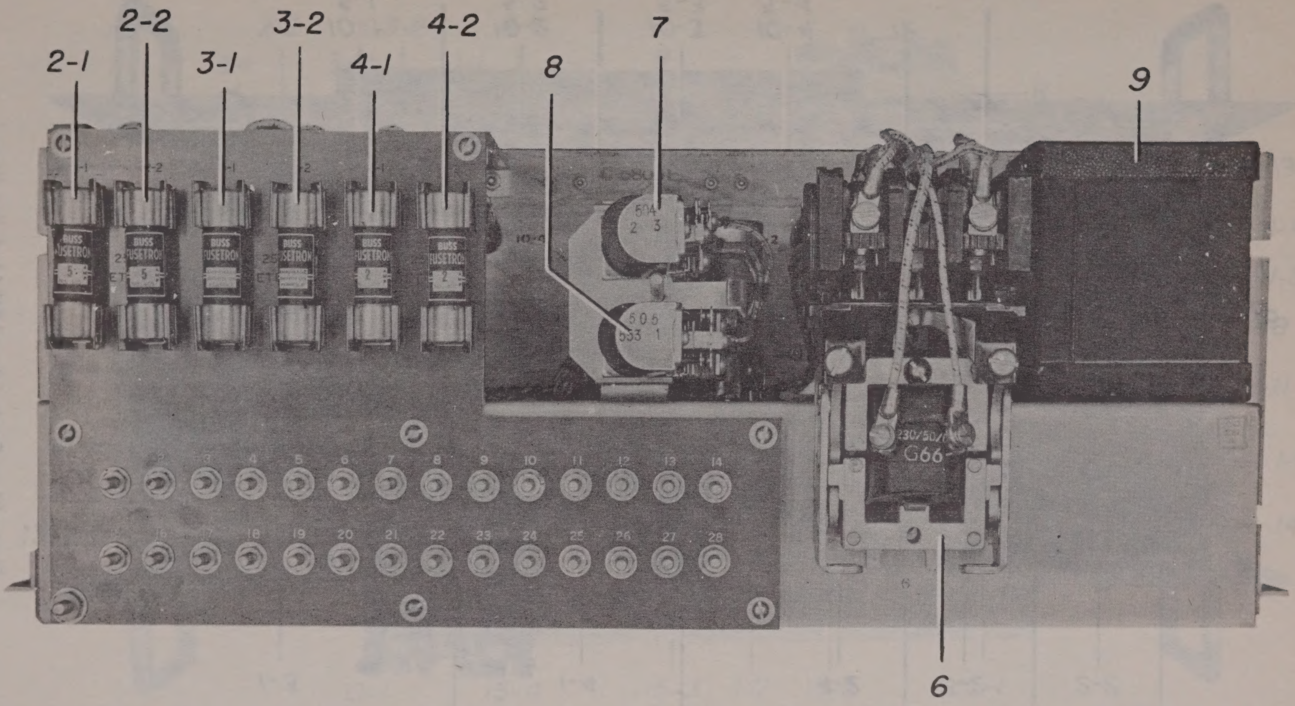

2-1
2-2
3-1
3-2
4-1
4-2
8
7
9
6

Figure 30 — Control Panel PN-11-A, Rear View

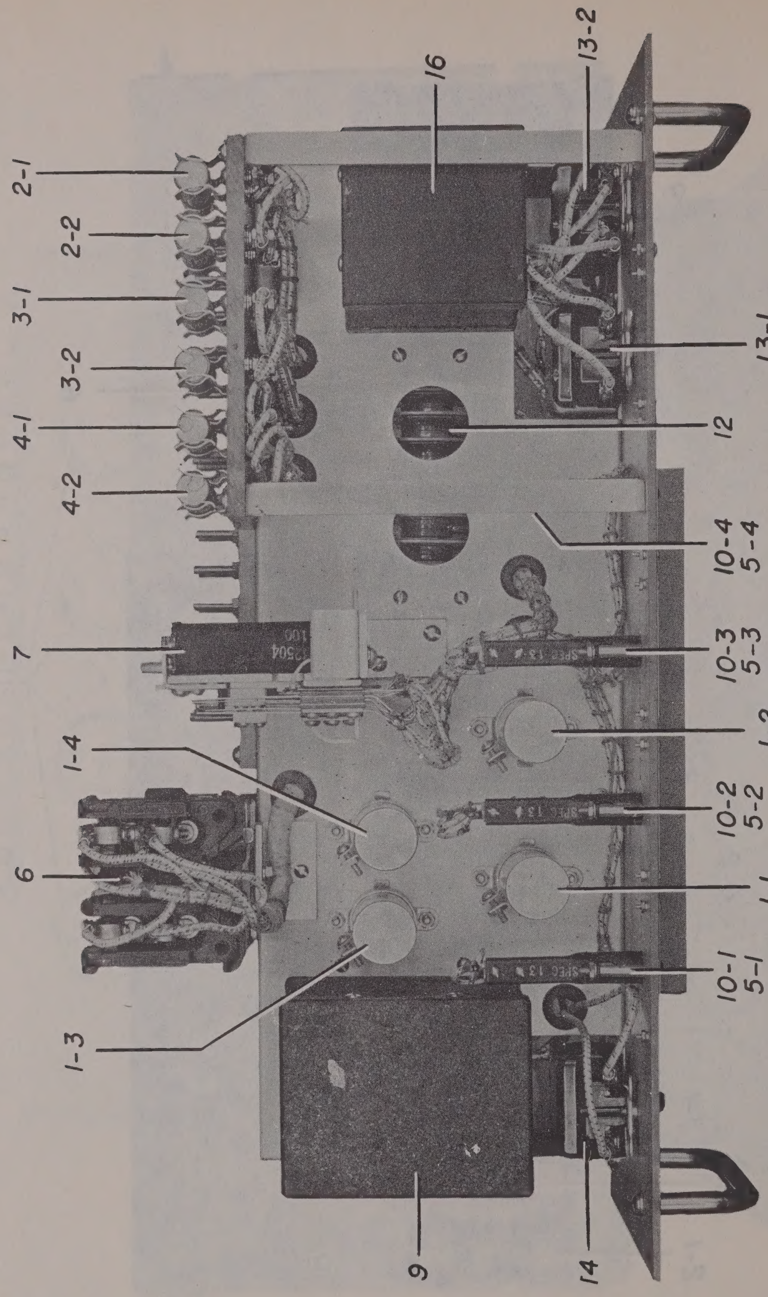

2-1
2-2
3-1
3-2
4-1
4-2
7
1-4
6
1-3
16
13-2
13-1
12
10-4
5-4
10-3
5-3
1-2
10-2
5-2
1-1
10-1
5-1
9
14

Figure 31 — Control Panel PN-11-A, Top View

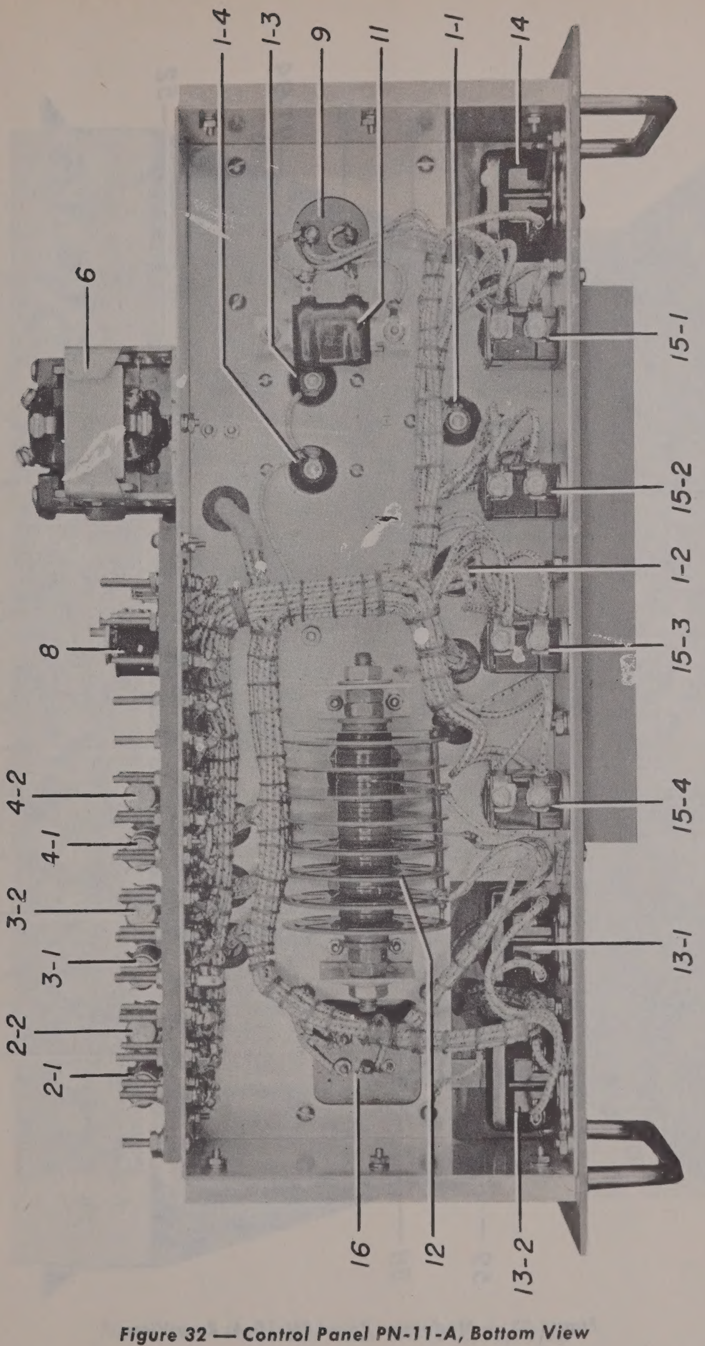

1-4
1-3
9
11
1-1
14
6
15-1
15-2
1-2
8
15-3
4-2
4-1
15-4
3-2
3-1
13-1
2-2
2-1
16
12
13-2

Figure 32 — Control Panel PN-11-A, Bottom View

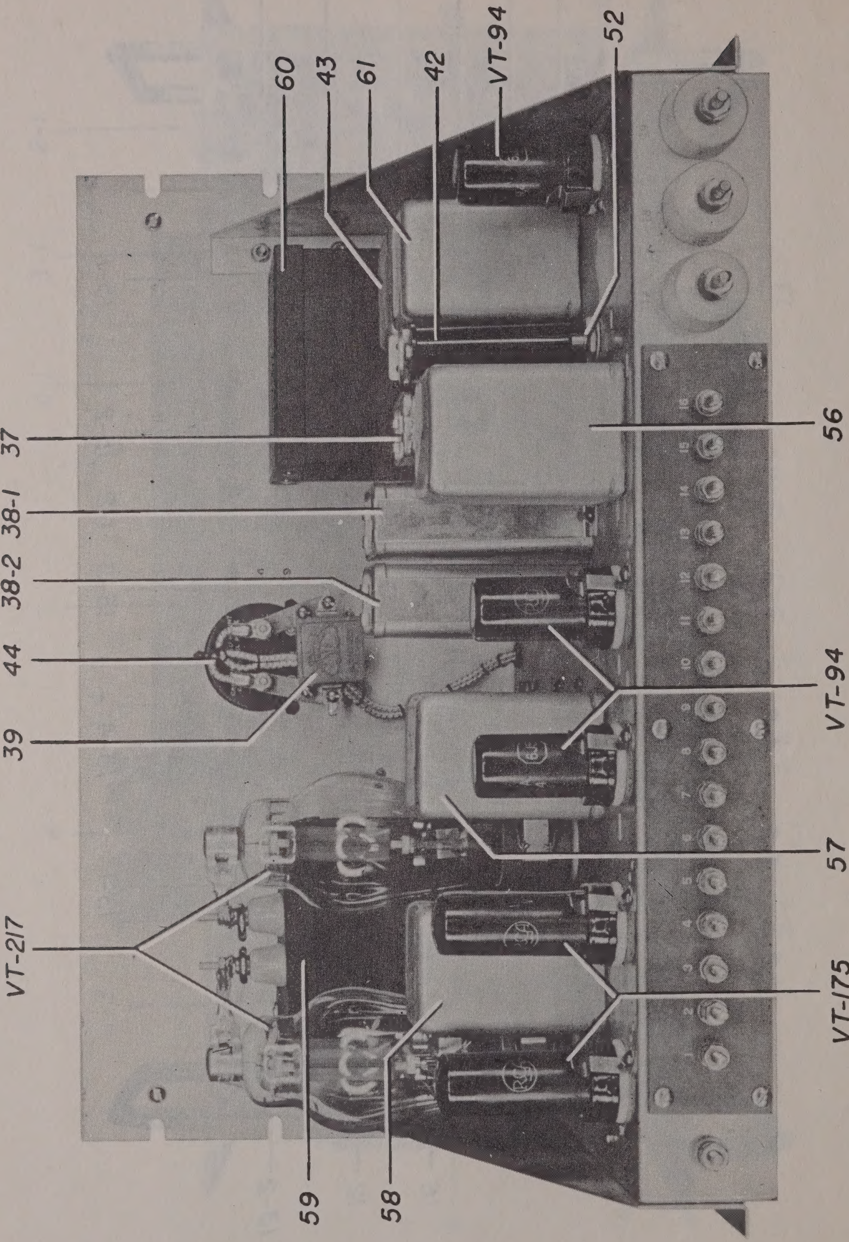

60
43
61
42
VT-94
52
37
38-1
38-2
44
39
VT-217
59
58
56
VT-94
57
VT-175

Figure 33 — Modulator Panel PN-10-A, Rear View

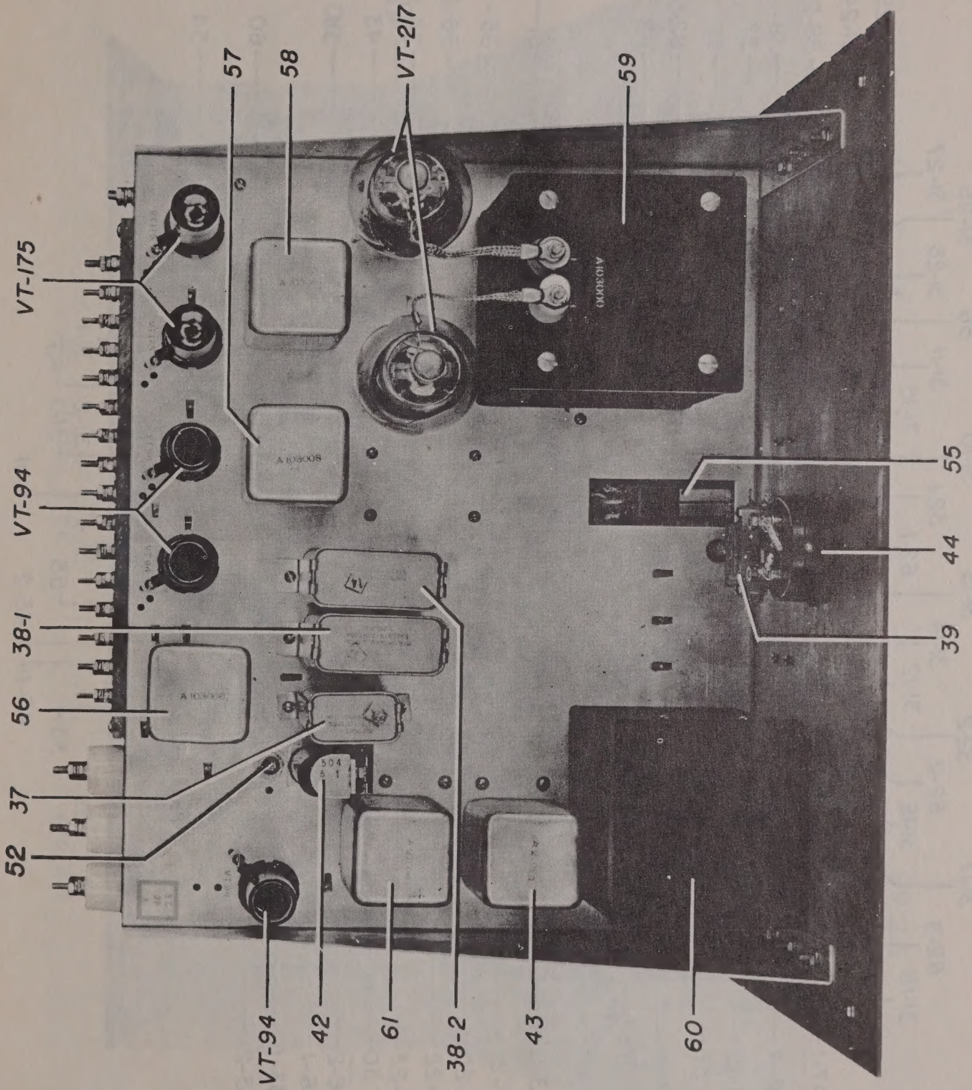

57
58
VT-217
59
55
44
39
60
43
38-2
61
42
VT-94
52
37
56
38-1
VT-94
VT-175

Figure 34 — Modulator Panel PN-10-A, Top View

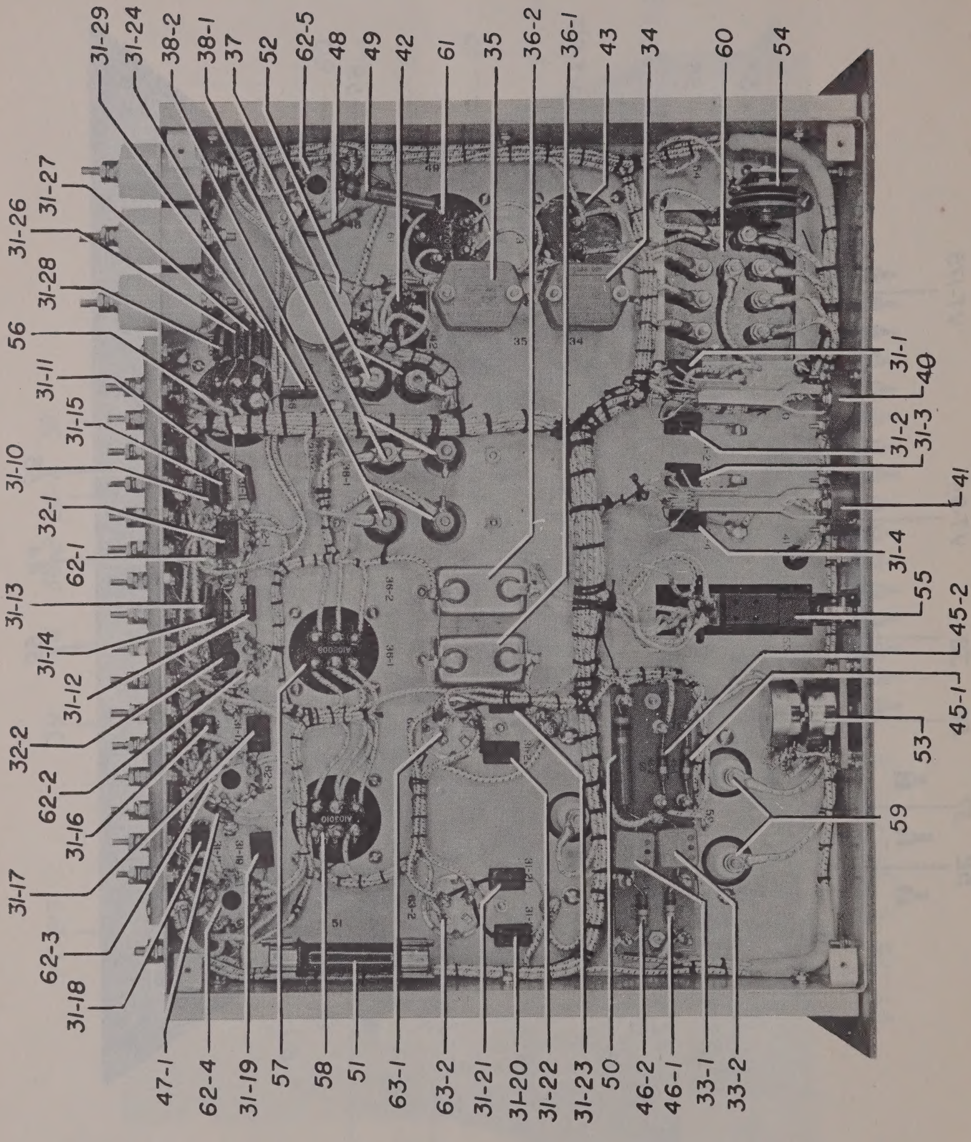

31-29
31-24
38-2
38-1
37
52
62-5
48
49
42
61
35
36-2
36-1
43
34
60
54
31-1
40
31-2
31-3
41
31-4
55
45-2
45-1
53
59
33-2
33-1
46-1
46-2
50
31-23
31-22
31-20
31-21
63-2
63-1
51
58
57
31-19
62-4
47-1
31-18
62-3
31-17
31-16
62-2
32-2
31-12
31-14
31-13
62-1
32-1
31-10
31-15
31-11
56
31-28
31-26
31-27

Figure 35 — Modulator Panel PN-10-A, Bottom View

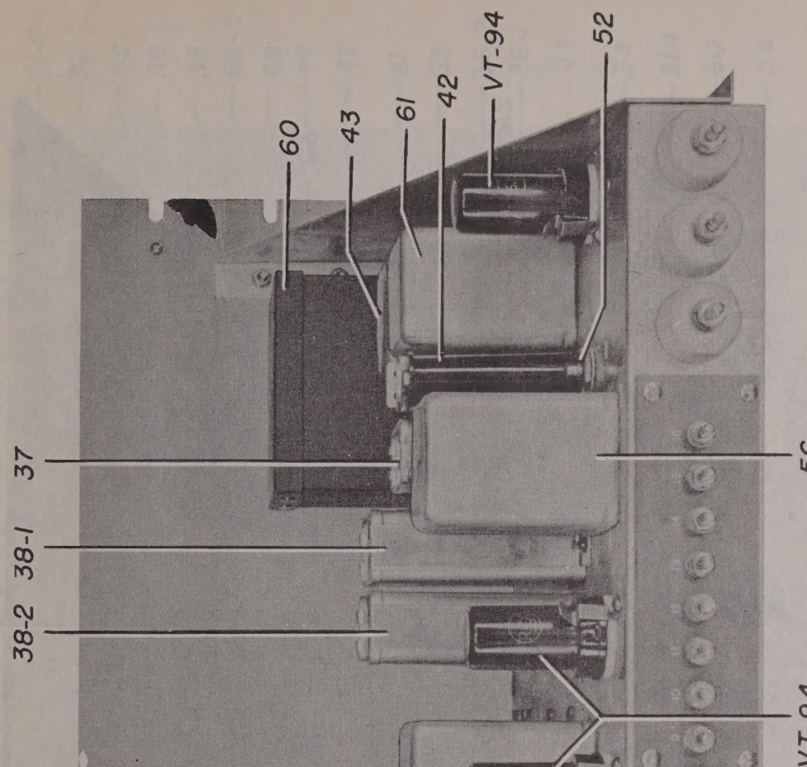

60
43
61
42
VT-94
52
37
38-1
38-2
56
VT-94
57
VT-217
VT-175
OR
VT-66
59
58

Figure 36 — Modulator Panel PN-10-B, Rear View

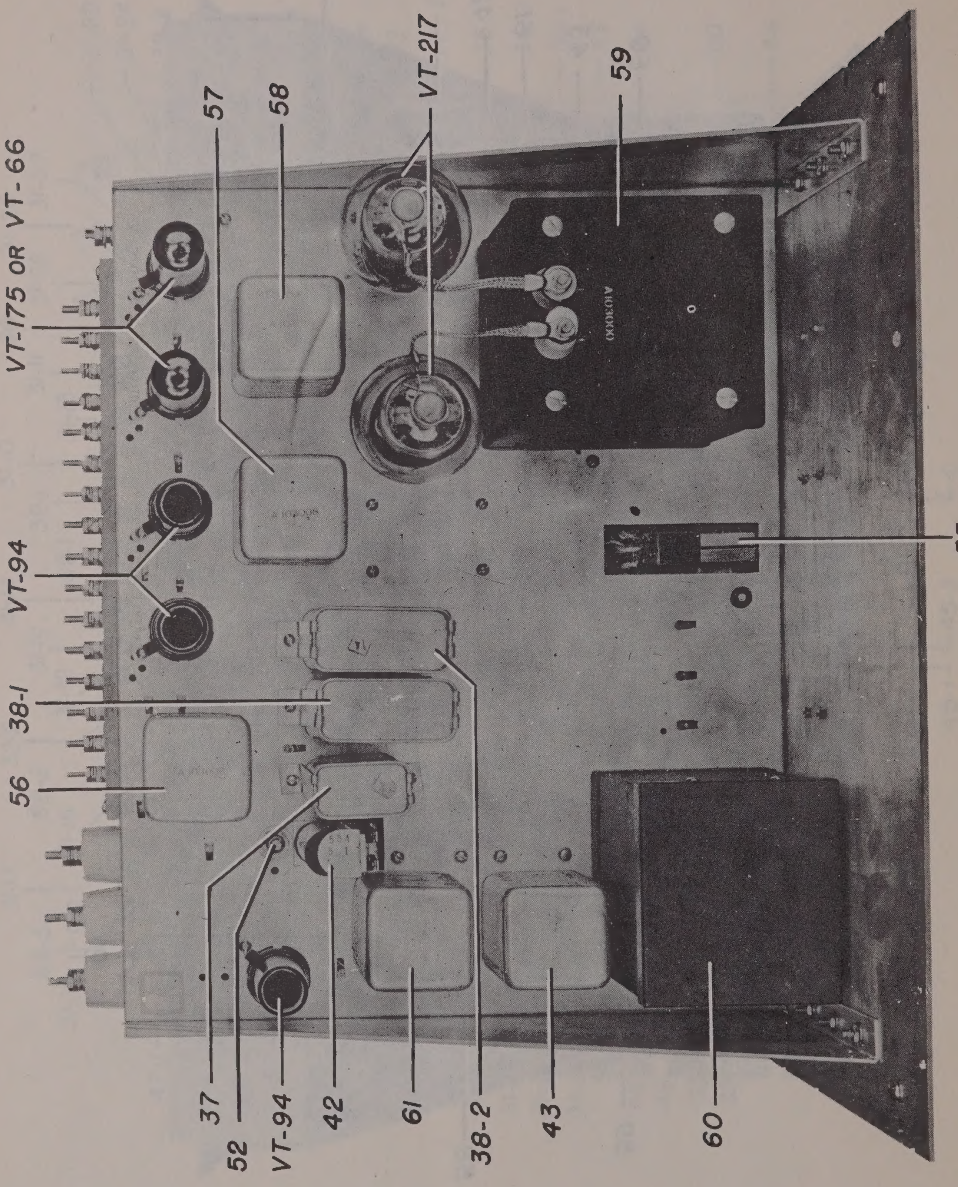

VT-175 OR VT-66
VT-94
38-1
56
57
58
VT-217
59
55
60
43
38-2
61
42
VT-94
52
37

Figure 37 — Modulator Panel PN-10-B, Top View

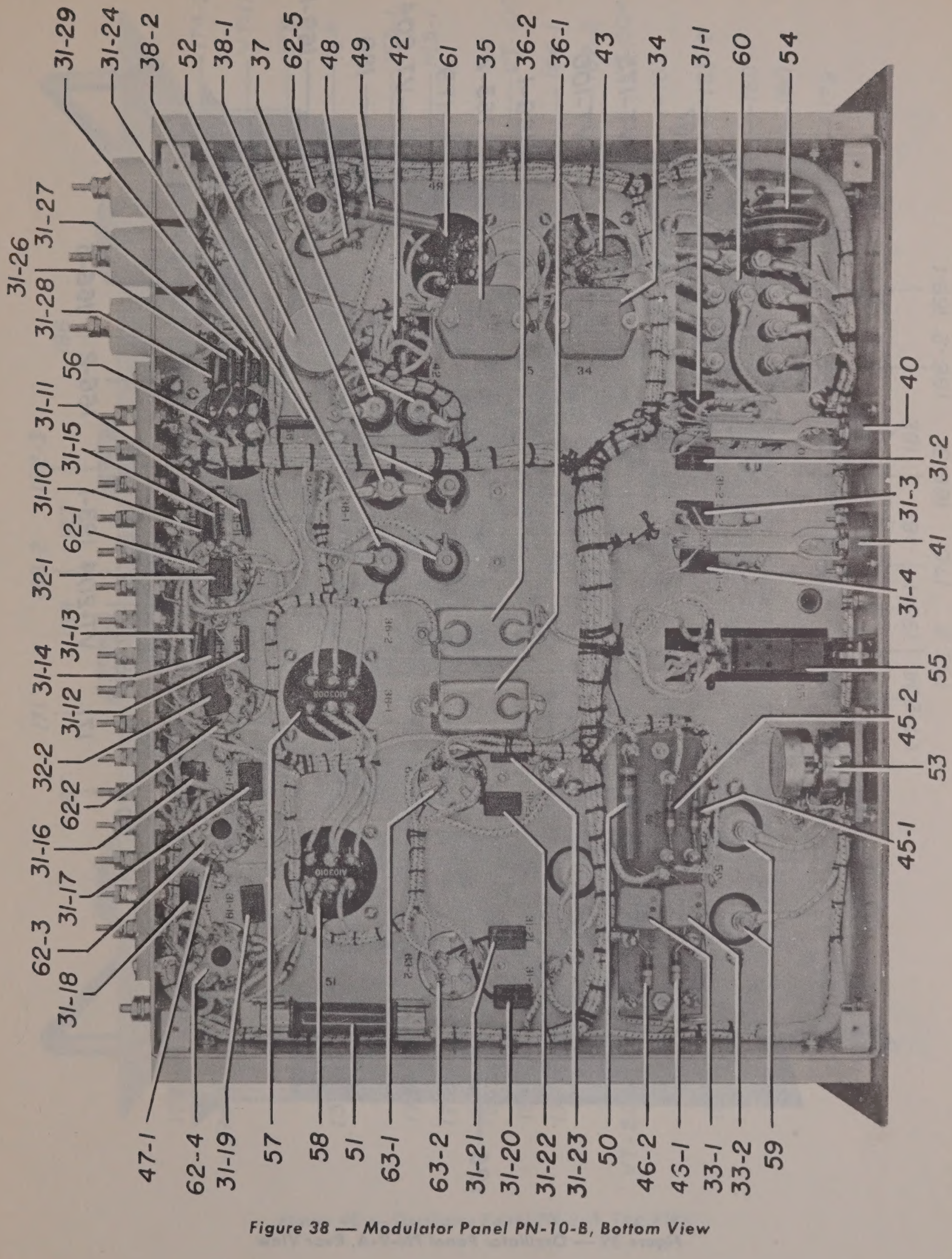

31-29
31-24
38-2
52
38-1
37
62-5
48
49
42
61
35
36-2
36-1
43
34
31-1
60
54
40
31-2
31-3
41
31-4
55
45-2
53
45-1
59
33-2
33-1
45-1
46-2
50
31-23
31-22
31-20
31-21
63-2
63-1
51
58
57
31-19
62-4
47-1
31-18
62-3
31-17
31-16
62-2
32-2
31-12
31-14
31-13
32-1
62-1
31-10
31-15
31-11
56
31-28
31-26
31-27

Figure 38 — Modulator Panel PN-10-B, Bottom View

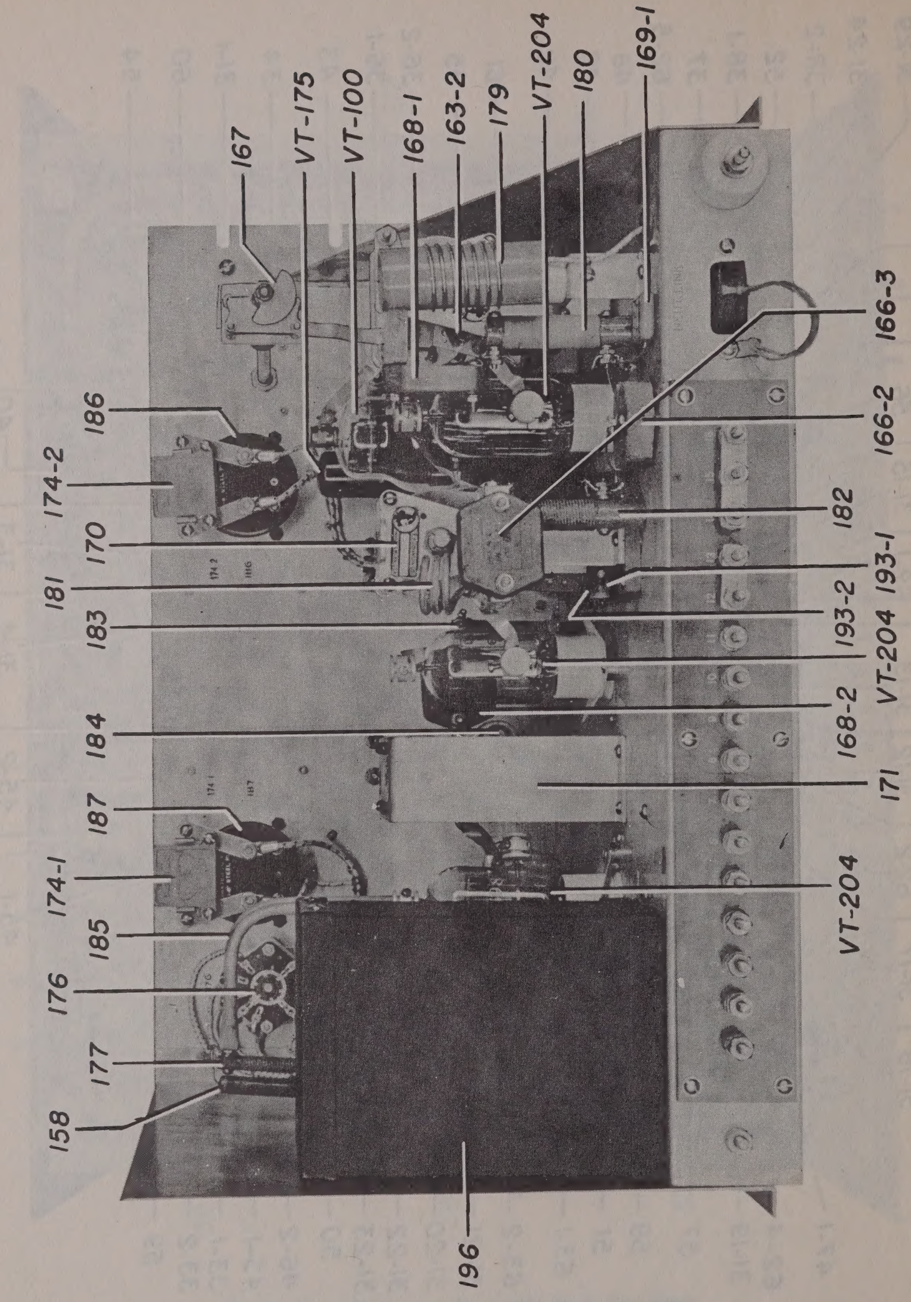

167
VT-175
VT-100
168-1
163-2
179
VT-204
180
169-1
186
174-2
170
181
183
184
187
174-1
185
176
177
158
196
166-3
166-2
182
193-1
193-2
VT-204
168-2
171
VT-204

Figure 39 — Oscillator Panel PN-9-A, Rear View

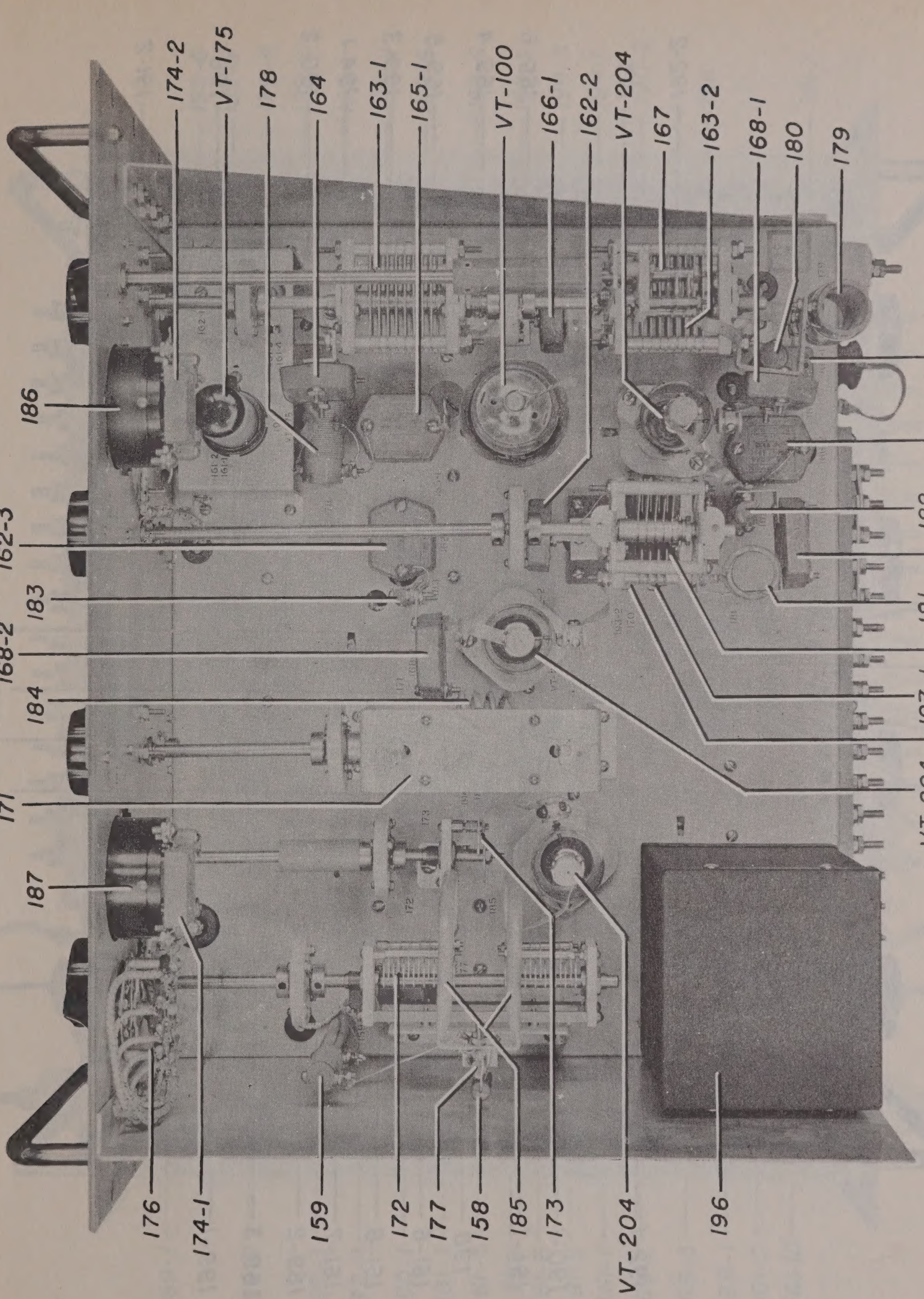

174-2
VT-175
178
164
163-1
165-1
VT-100
166-1
162-2
VT-204
167
163-2
168-1
180
179
186
162-3
183
168-2
184
171
187
169-1
166-2
182
166-3
181
170
193-1
193-2
VT-204
176
174-1
159
172
177
158
185
173
VT-204
196

Figure 40 — Oscillator Panel PN-9-A, Top View

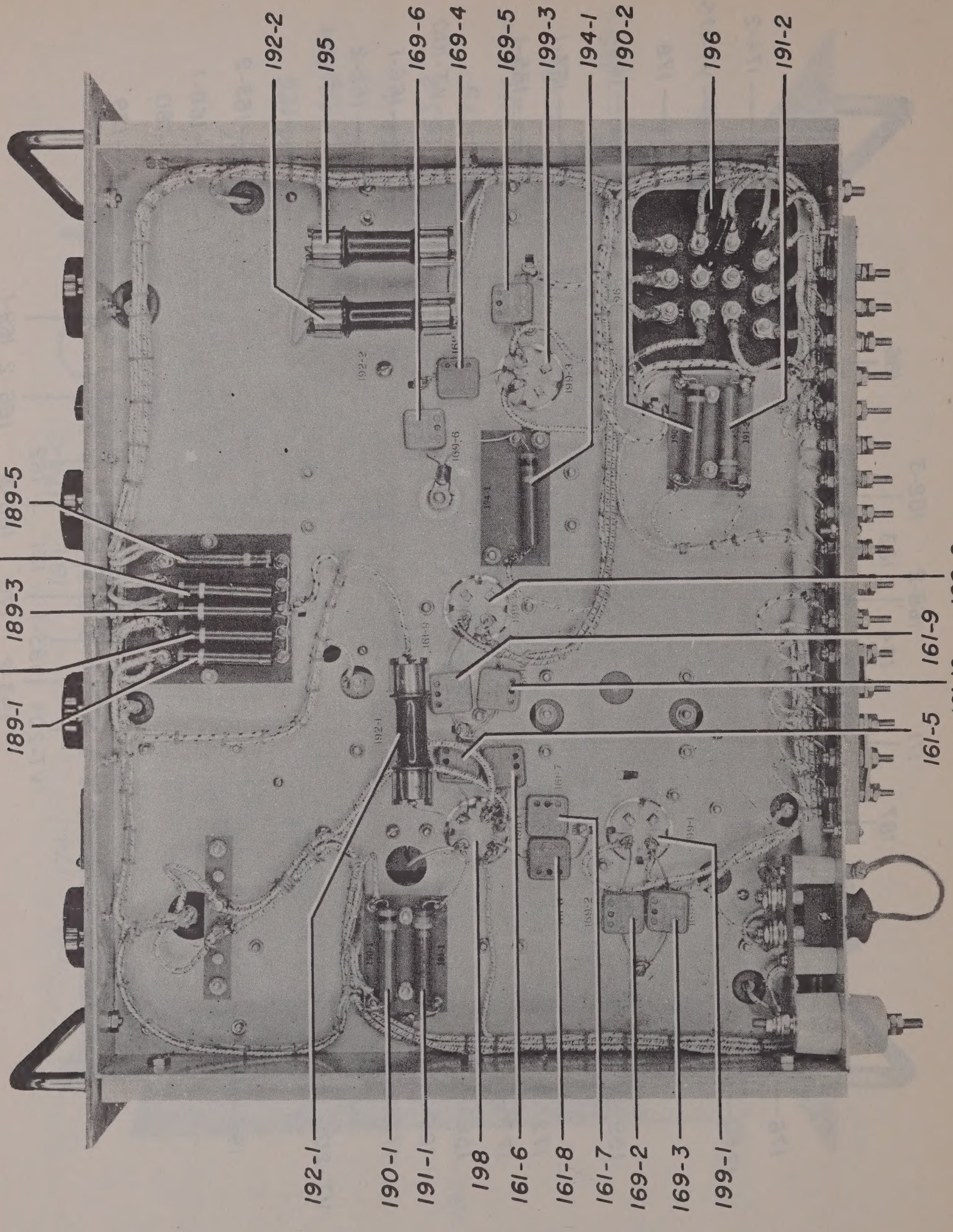

192-2
195
169-6
169-4
169-5
199-3
194-1
190-2
196
191-2
189-5
189-4
189-3
189-2
189-1
199-2
161-9
161-10
161-5
192-1
190-1
191-1
198
161-6
161-8
161-7
169-2
169-3
199-1

Figure 41 — Oscillator Panel PN-9-A, Bottom View

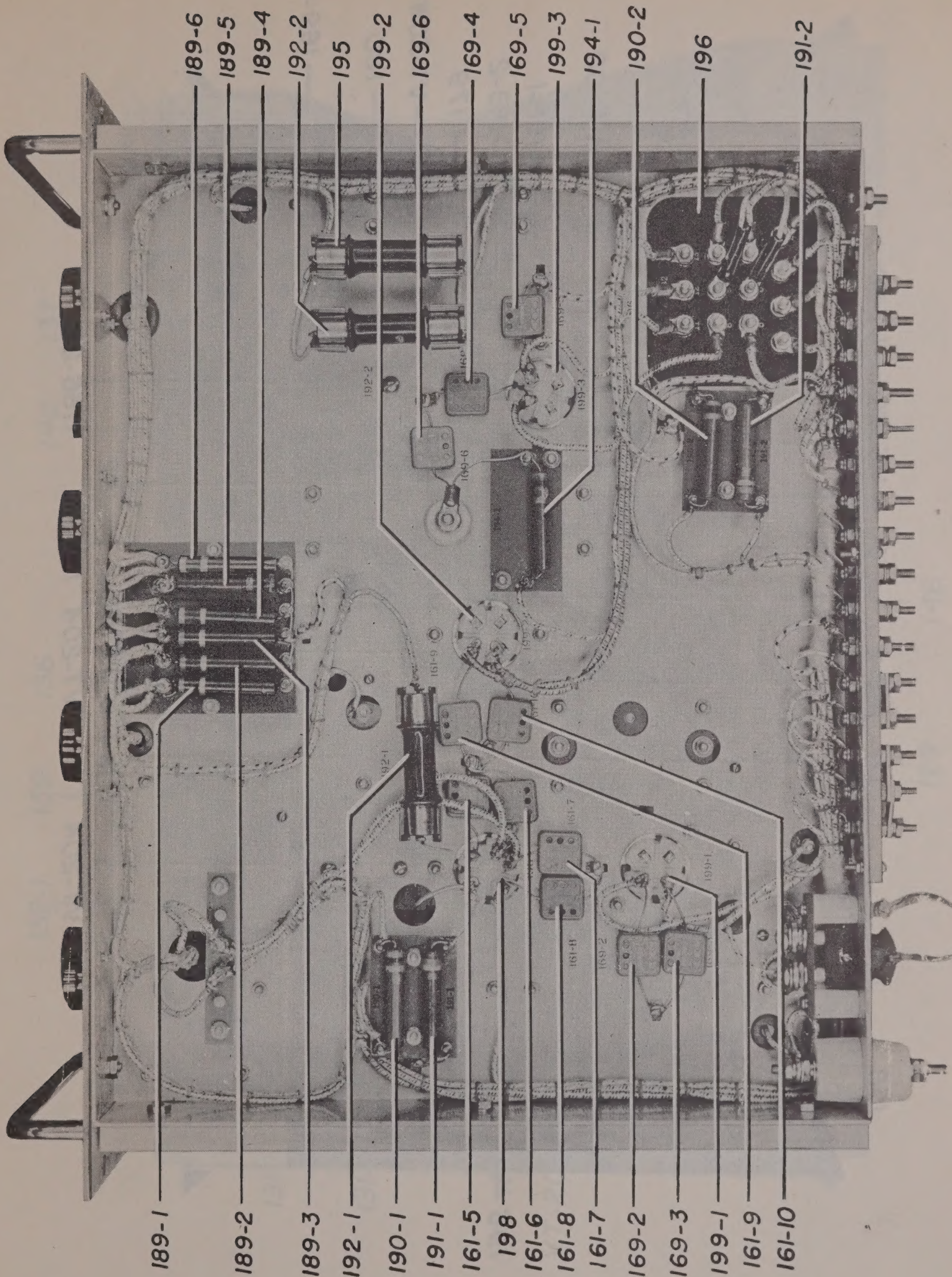

189-6
189-5
189-4
192-2
195
199-2
169-6
169-4
169-5
199-3
194-1
190-2
196
191-2
189-1
189-2
189-3
192-1
190-1
191-1
161-5
198
161-6
161-8
161-7
169-2
169-3
199-1
161-9
161-10

Figure 42 — Oscillator Panel PN-9-B, Bottom View

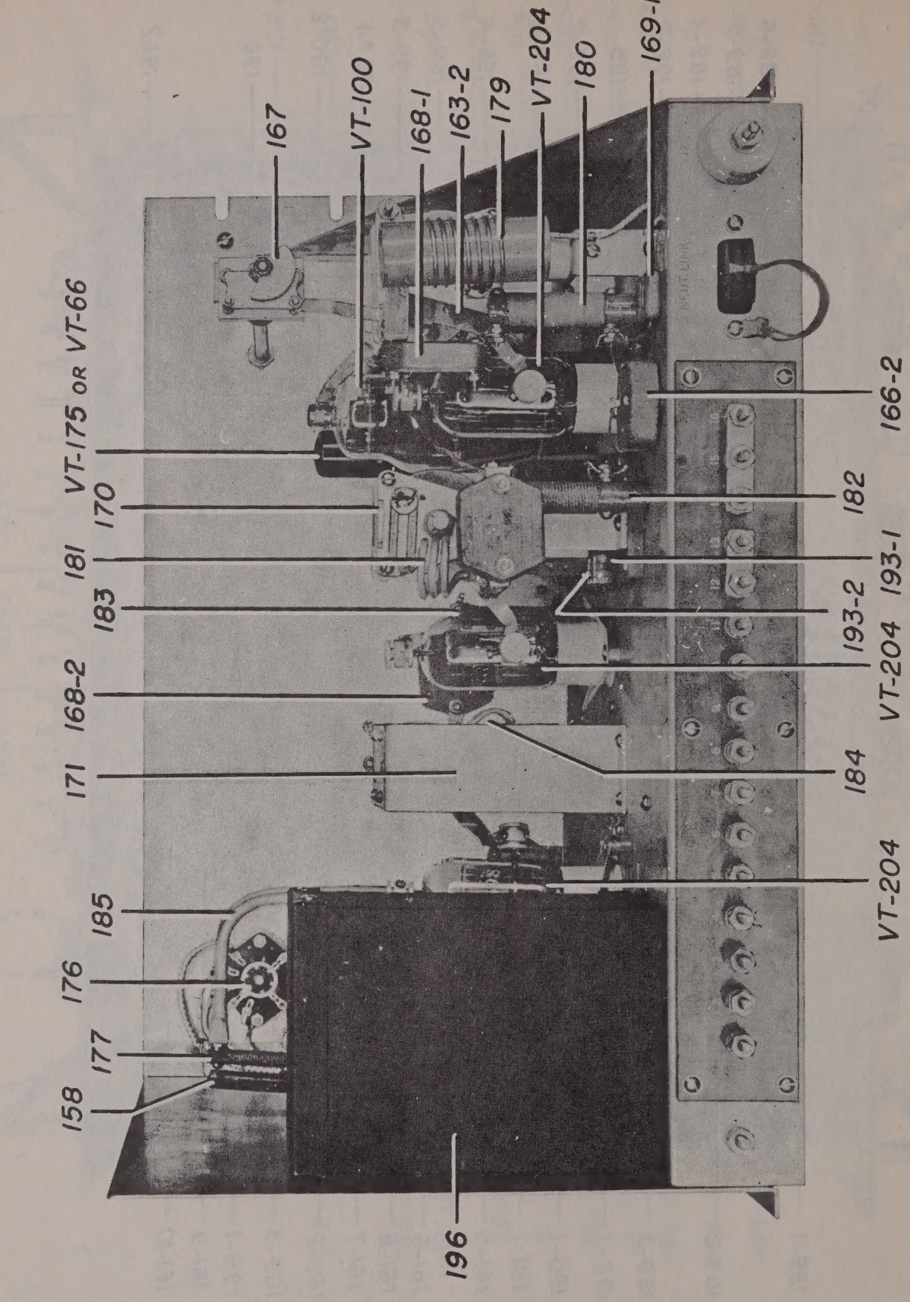

VT-175 OR VT-66
167
VT-100
168-1
163-2
179
VT-204
180
169-1
166-2
182
193-1
193-2
VT-204
184
VT-204
170
181
183
168-2
171
185
176
177
158
196

Figure 43 — Oscillator Panel PN-9-B, Rear View

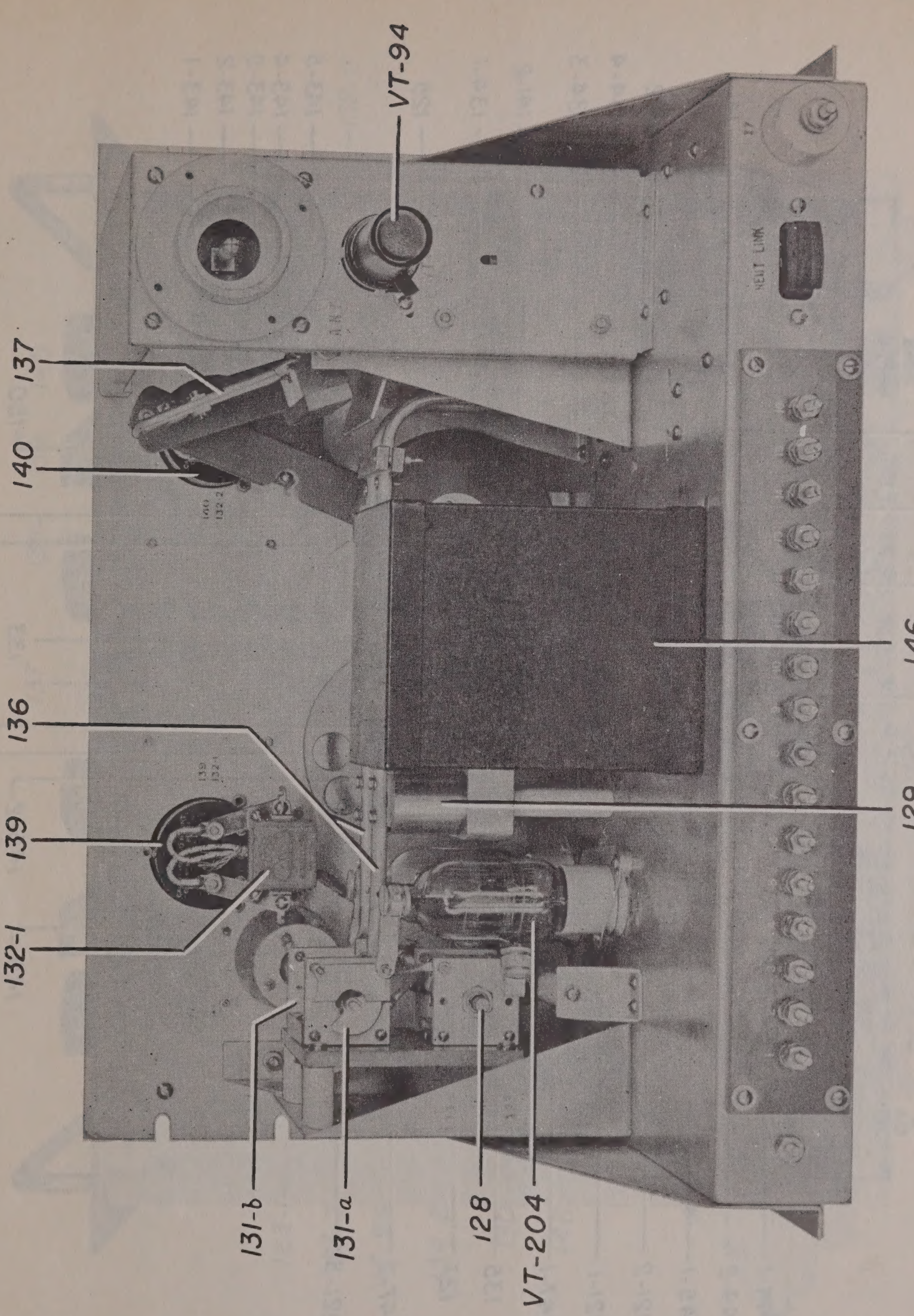

VT-94
137
140
136
139
132-1
146
129
131-b
131-a
128
VT-204

Figure 44 — Amplifier Panel PN-8-A, Rear View

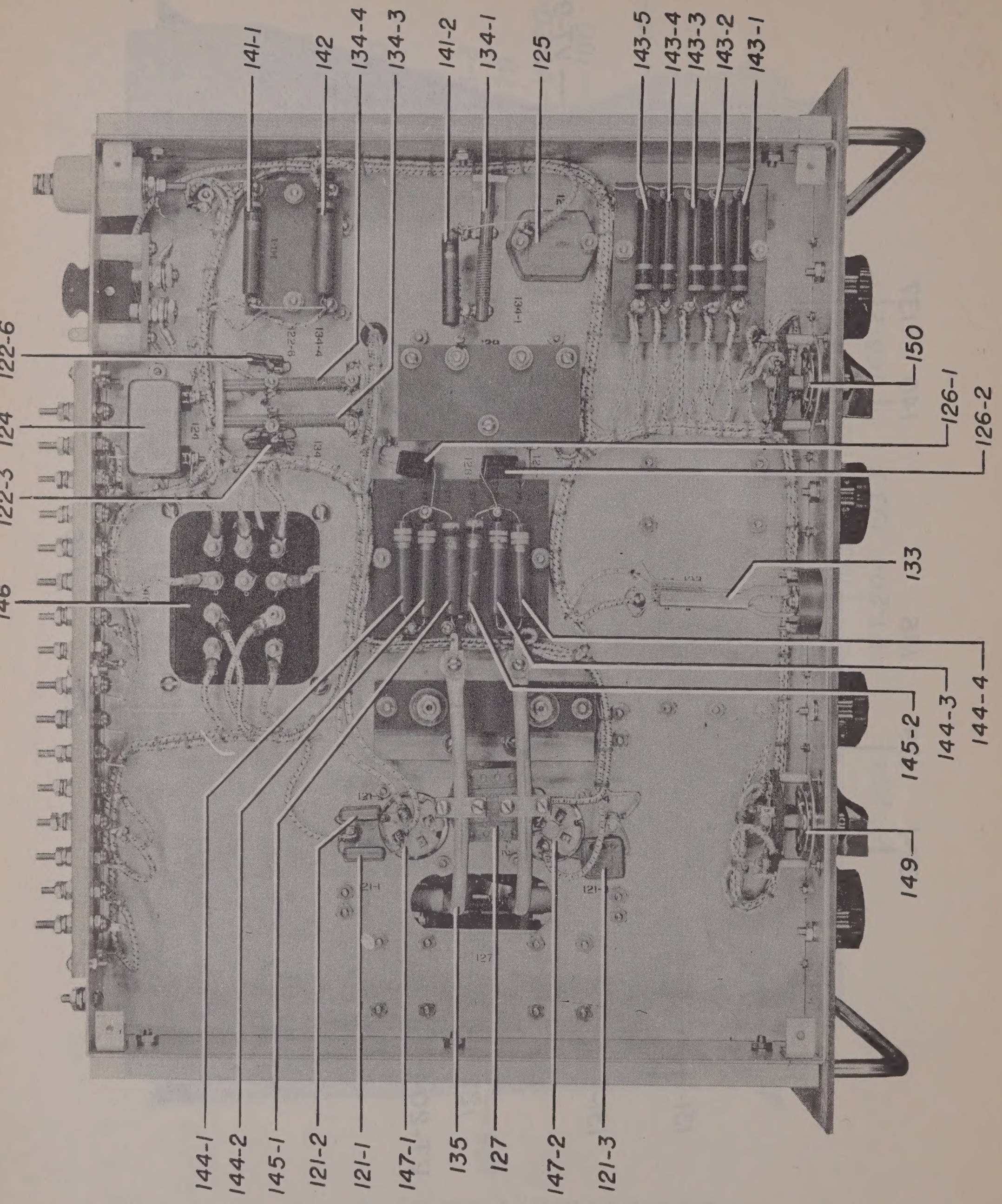

141-1
142
134-4
134-3
141-2
134-1
125
143-5
143-4
143-3
143-2
143-1
122-6
124
122-3
146
150
126-1
126-2
133
144-4
144-3
145-2
149
144-1
144-2
145-1
121-2
121-1
147-1
135
127
147-2
121-3

Figure 45 — Amplifier Panel PN-8-A, Bottom View

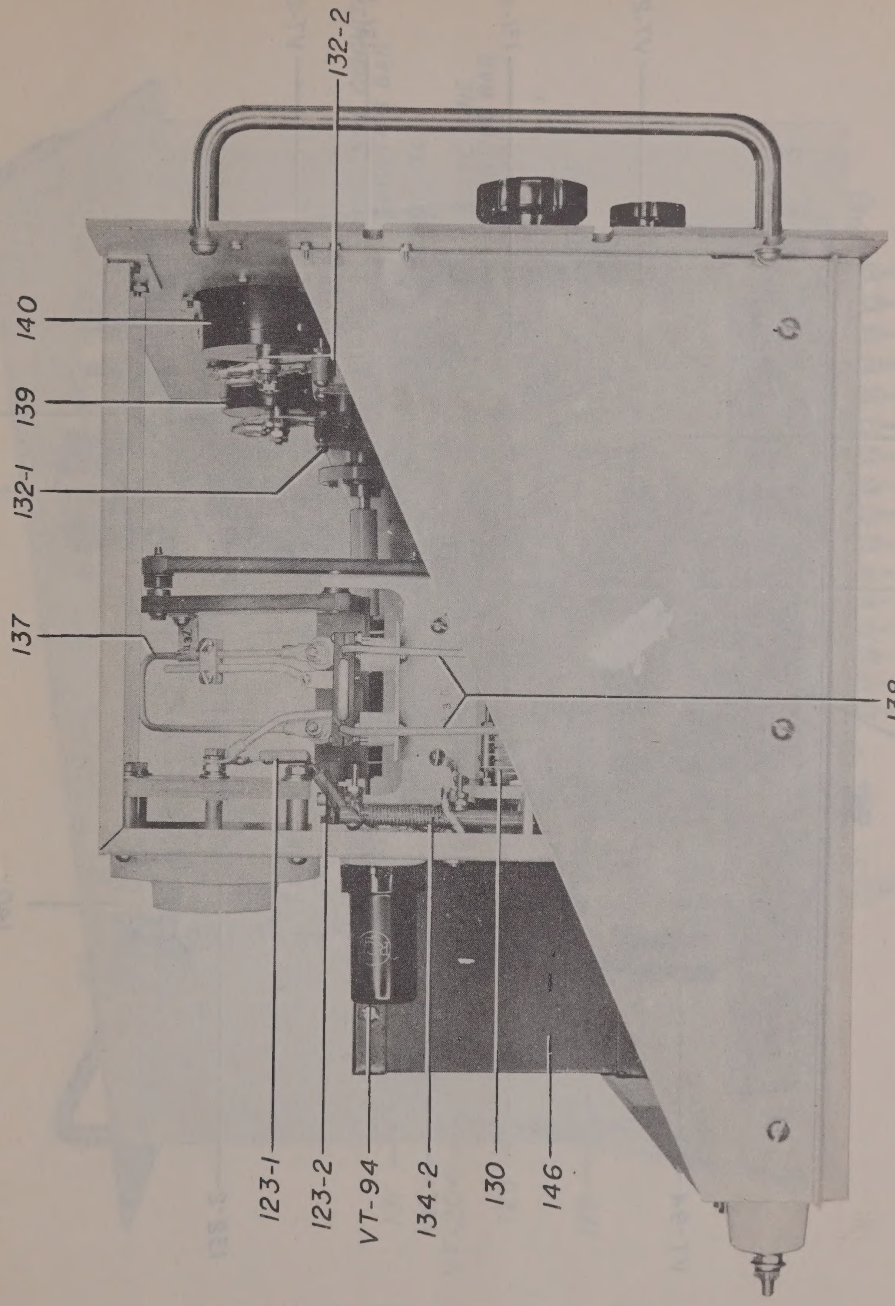

132-2
140
139
132-1
137
138
123-1
123-2
VT-94
134-2
130
146

Figure 46 — Amplifier Panel 'N-8-A, Left Side View

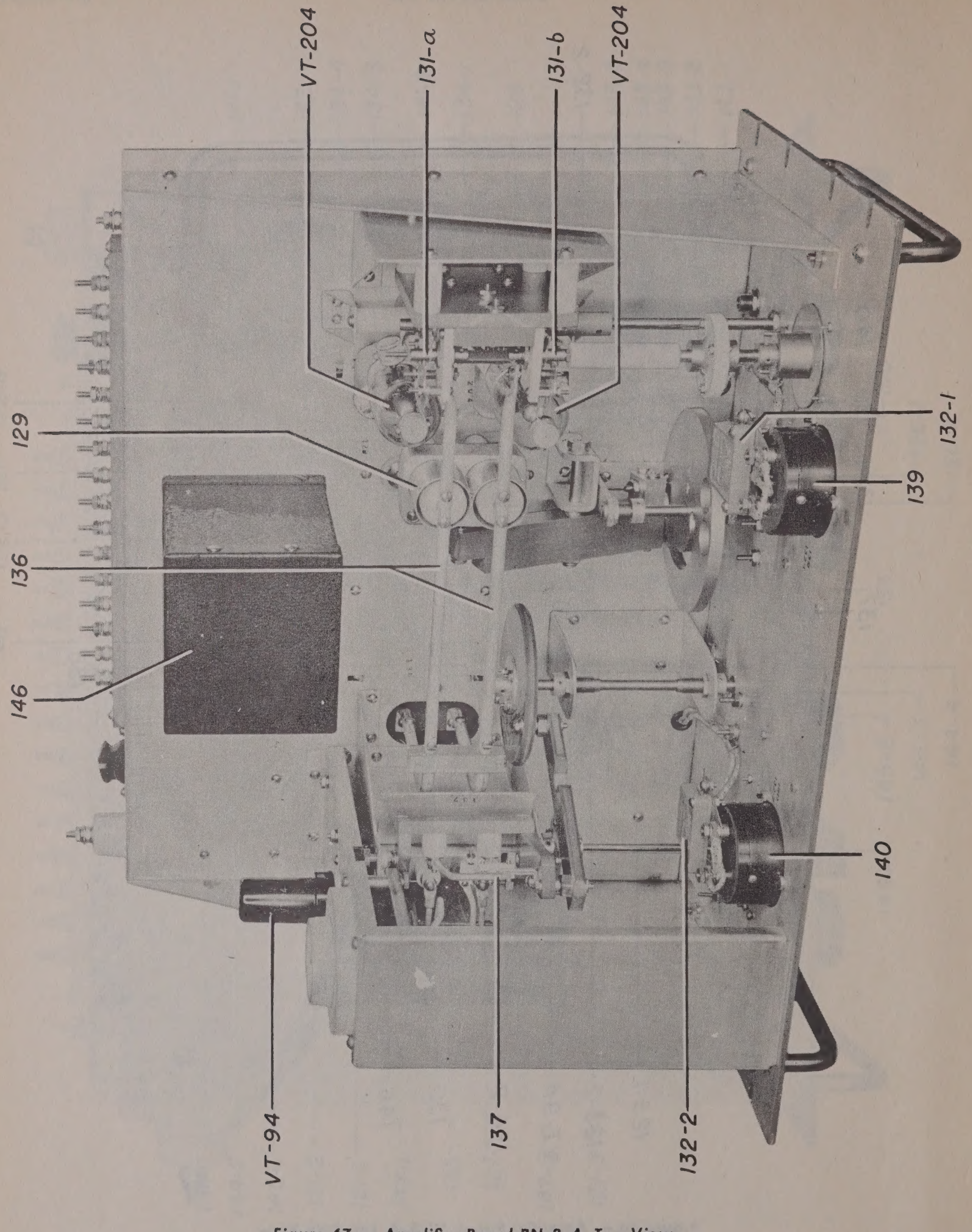

VT-204
131-a
131-b
VT-204
129
132-1
139
136
146
140
VT-94
137
132-2

Figure 47 — Amplifier Panel PN-8-A, Top View

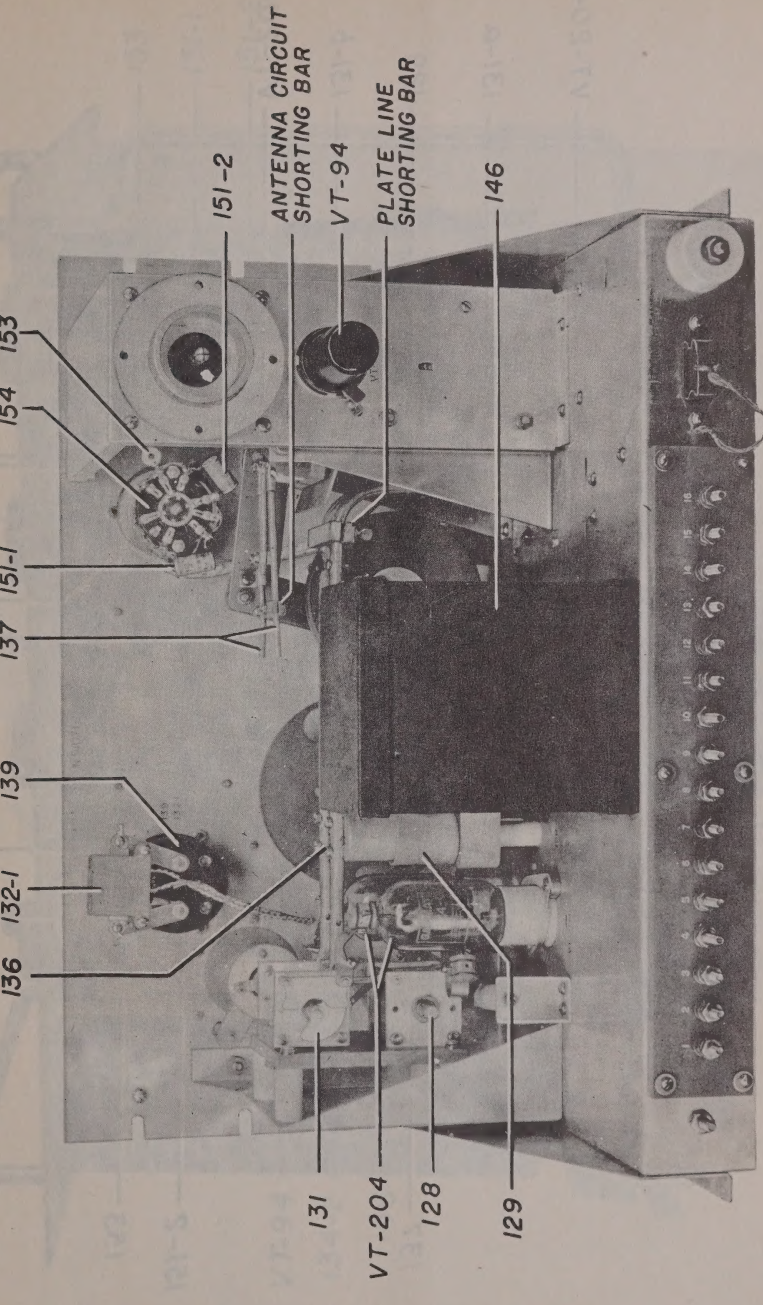
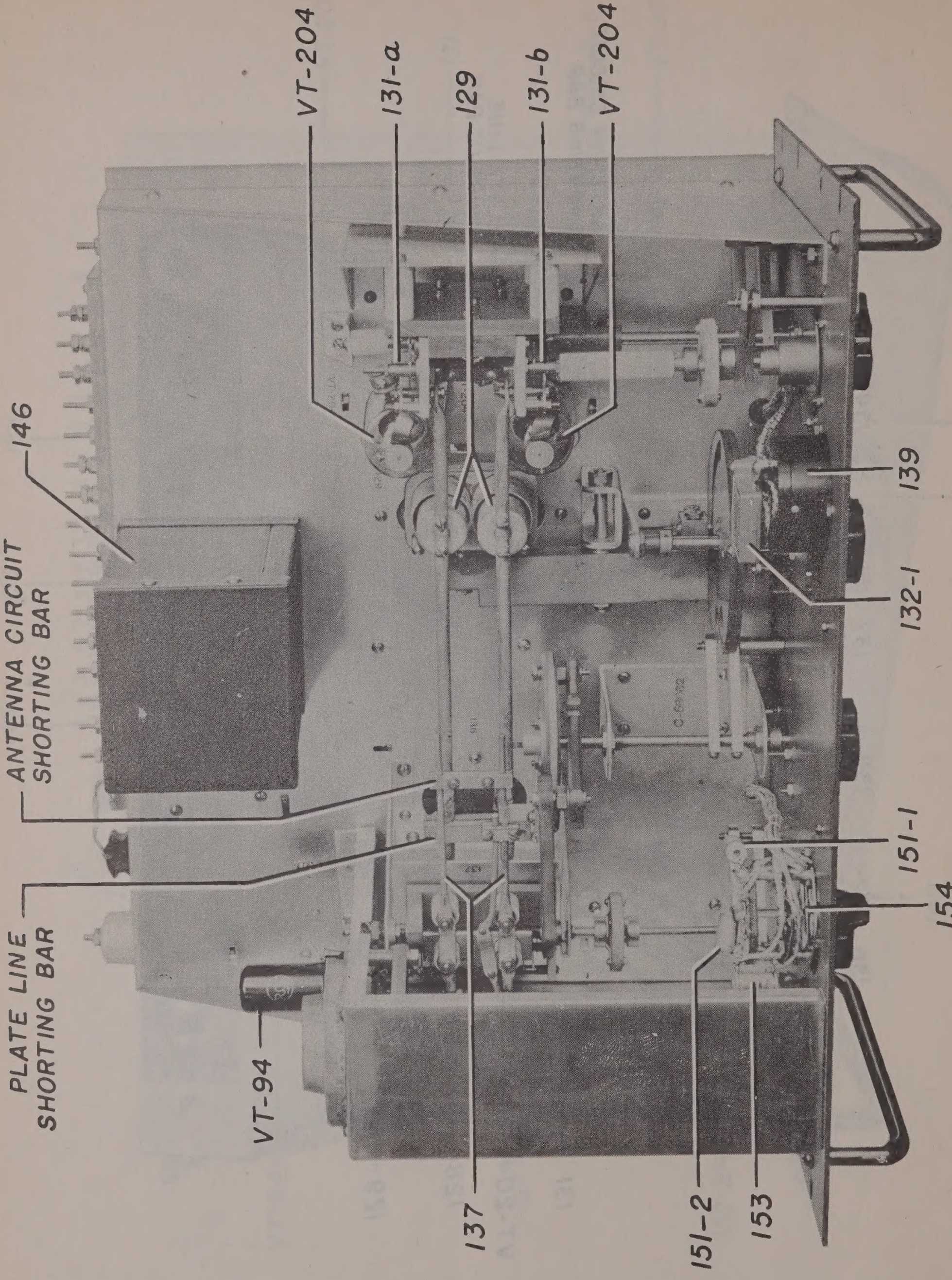

153
154
151-1
137
139
132-1
136
151-2
ANTENNA CIRCUIT SHORTING BAR
VT-94
PLATE LINE SHORTING BAR
146
131
VT-204
128
129

Figure 48 — Amplifier Panel PN-8-B, Rear View



VT-204
131-a
129
131-b
VT-204
146
ANTENNA CIRCUIT SHORTING BAR
PLATE LINE SHORTING BAR
VT-94
137
151-2
153
154
151-1
132-1
139

Figure 49 — Amplifier Panel PN-8-B, Top View

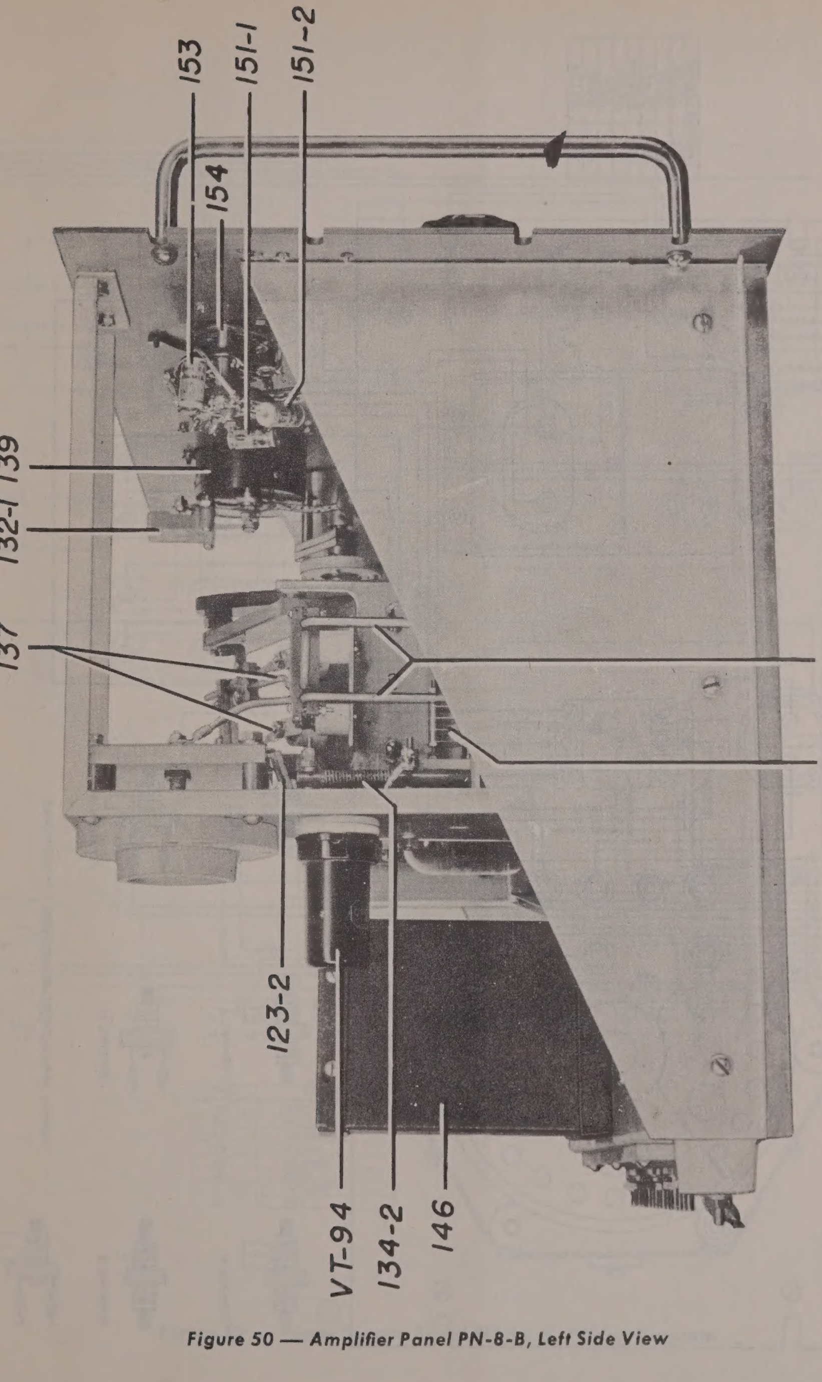
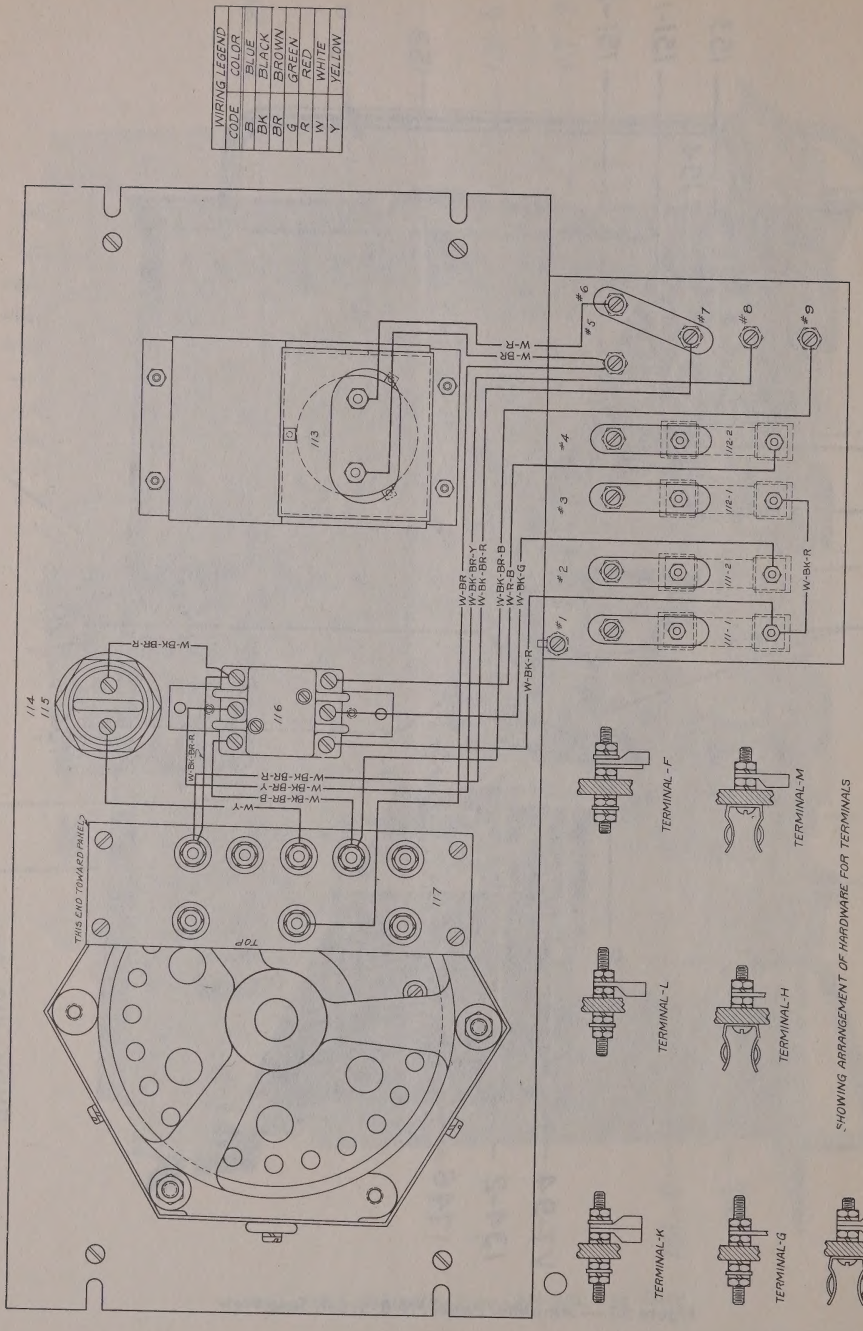

153
151-1
151-2
154
139
132-1
137
138
130
123-2
VT-94
134-2
146

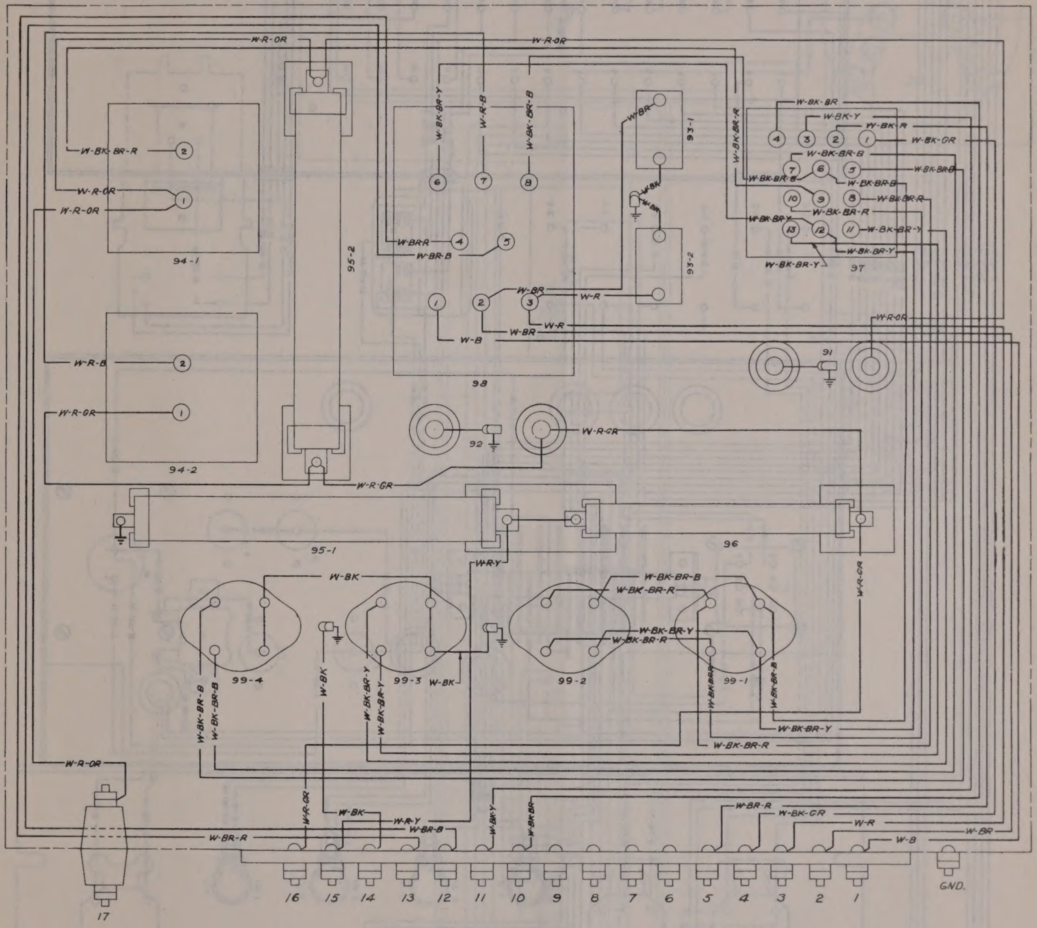
Figure 50 — Amplifier Panel PN-8-B, Left Side View



WIRING LEGEND	
CODE	COLOR
B	BLUE
BK	BLACK
BR	BROWN
G	GREEN
R	RED
W	WHITE
Y	YELLOW

THIS END TOWARD PANEL
TOP
117
114
115
116
113
W-R
W-BR
W-BR
W-BK-BR-Y
W-BK-BR-R
W-BK-BR-B
W-R-B
W-BK-G
W-BK-R
W-BK-BR-R
W-BK-BR-R
W-BK-BR-Y
W-BK-BR-B
W-Y
W-BK-R
#1
#2
#3
#4
#5
#6
#7
#8
#9
111-1
111-2
112-1
112-2
TERMINAL-F
TERMINAL-M
TERMINAL-L
TERMINAL-H
TERMINAL-K
TERMINAL-G
TERMINAL-J
SHOWING ARRANGEMENT OF HARDWARE FOR TERMINALS

Figure 51 — Power Control Panel PN-13-A, and PN-13-B, Wiring Diagram


W-R-OR
W-R-OR
W-BK-BR-R
W-R-OR
W-R-OR
94-1
W-R-B
W-R-GR
94-2
95-2
W-BK-BR-Y
W-R-B
W-BK-BR-B
W-BR-R
W-BR-B
W-BR
W-BR
W-B
W-R
W-R
98
93-1
93-2
W-BK
W-BK
W-BK-BR-R
W-BK-BR
W-BK-Y
W-BK-R
W-BK-GR
W-BK-BR-B
W-BK-BR-B
W-BK-BR-B
W-BK-BR-R
W-BK-BR-R
W-BK-BR-R
W-BK-BR-Y
W-BK-BR-Y
W-BK-BR-Y
W-BK-BR-Y
97
W-R-OR
91
92
W-R-GR
W-R-GR
95-1
96
W-R-Y
W-BK
W-BK-BR-B
W-BK-BR-R
W-BK-BR-Y
W-BK-BR-R
W-R-GR
99-4
99-3
99-2
99-1
W-BK
W-BK-BR-B
W-BK-BR-B
W-BK-BR-Y
W-BK-BR-Y
W-BK-BR-R
W-BK-BR-B
W-BK-BR-Y
W-BK-BR-R
W-R-OR
W-BR-R
W-R-OR
W-BK
W-R-Y
W-BR-B
W-BK-Y
W-BK-BR
W-BR-R
W-BK-GR
W-R
W-BR
W-B
GND.
16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1
17

CODE	COLOR
W	WHITE
BK	BLACK
BR	BROWN
GR	GREEN
OR	ORANGE
B	BLUE
Y	YELLOW
R	RED

Figure 52 — Power Supply Panel PN-12-A, Wiring Diagram

WIRING LEGEND.	
CODE	COLOR
B	BLUE
BK	BLACK
BR	BROWN
G	GREEN
O	ORANGE
R	RED
W	WHITE
Y	YELLOW

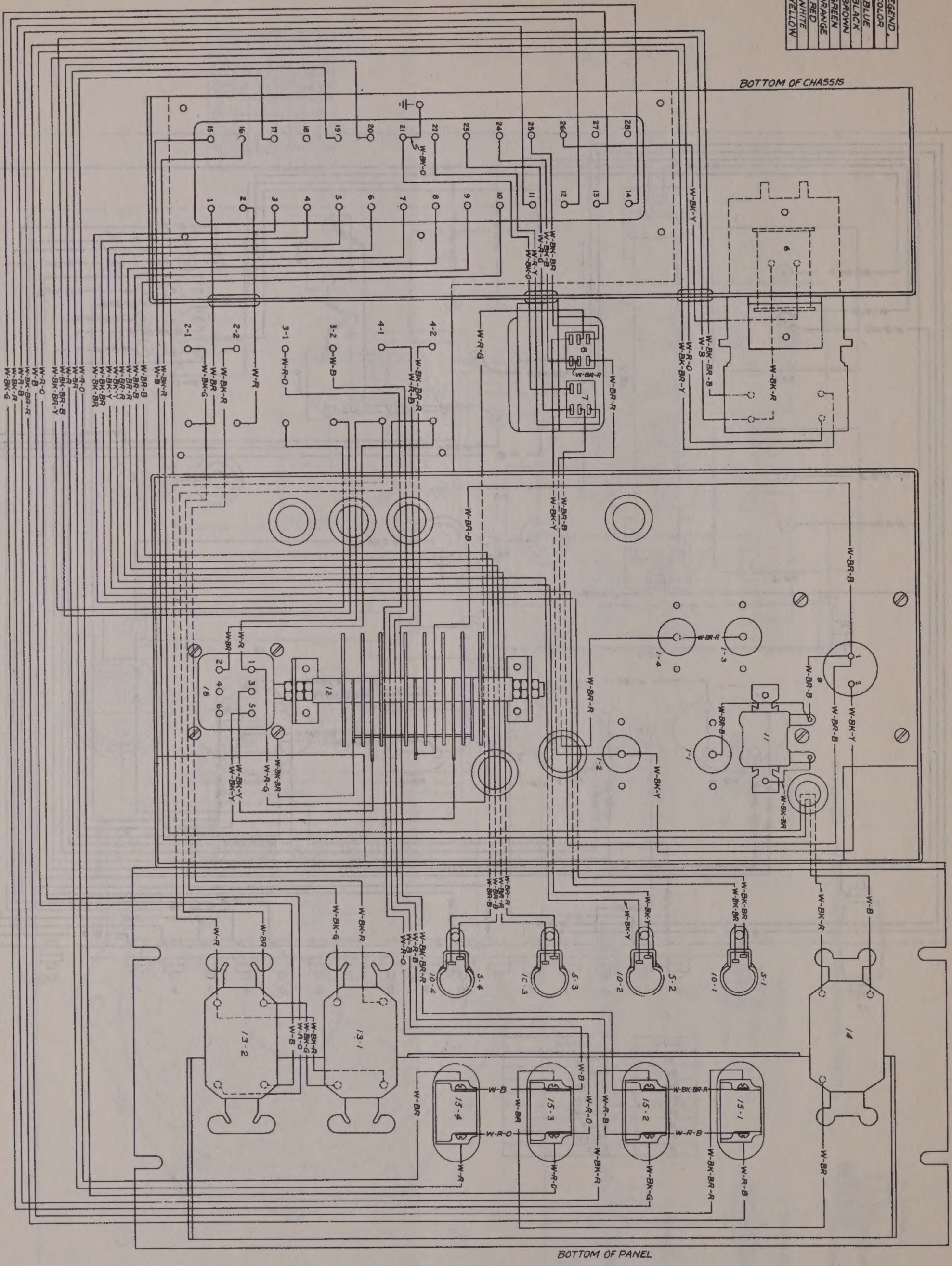
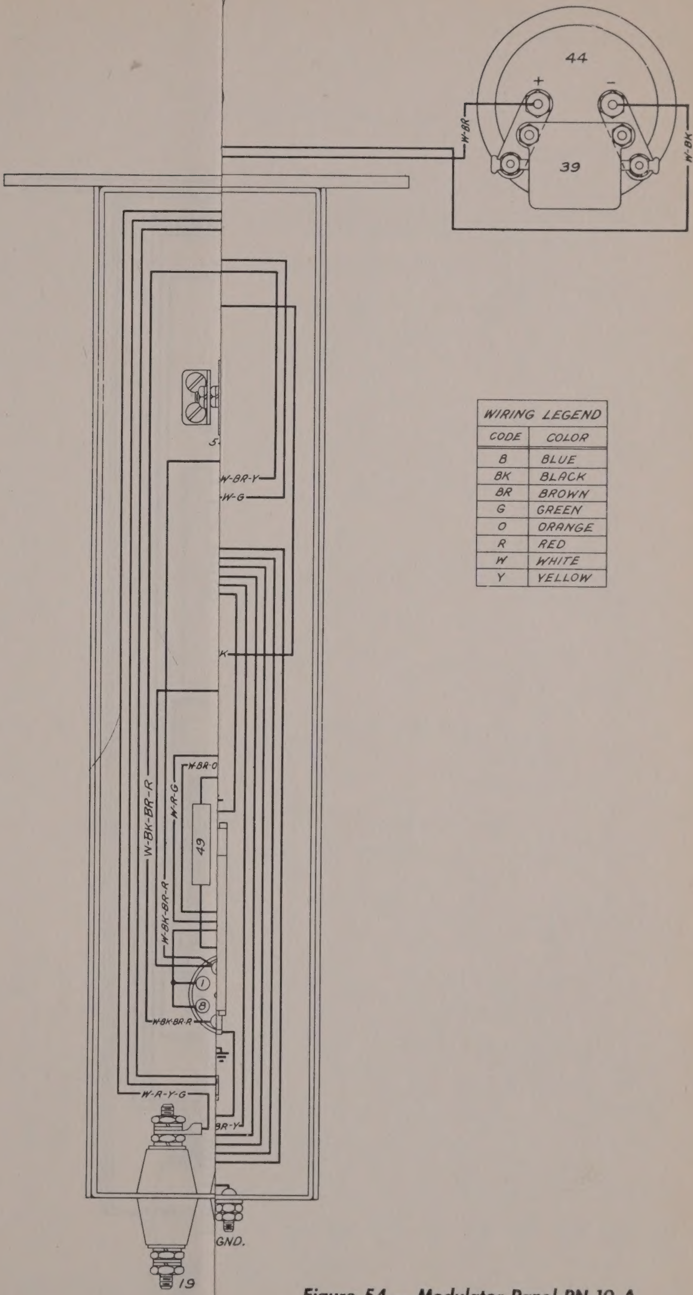

BOTTOM OF CHASSIS
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
2-1
2-2
3-1
3-2
4-1
4-2
6
7
8
9
1-1
1-2
1-3
1-4
11
12
16
13-1
13-2
14
15-1
15-2
15-3
15-4
S-1
S-2
S-3
S-4
10-1
10-2
10-3
10-4
W-BK-Y
W-BR-B
W-BR-R
W-R-G
W-BK-R
W-BK-G
W-B
W-R
W-BR
W-R-O
W-R-B
W-BK-BR
W-BK-BR-R
W-BK-BR-B
W-BK-BR-Y
W-BK-O
BOTTOM OF PANEL

Figure 53 — Control Panel PN-11-A, Wiring Diagram


44
+
−
39
W-BR
W-BK
5
W-BR-Y
W-G
K
W-BR-O
W-R-G
49
W-BK-BR-R
W-BK-BR-R
W-BK-BR-R
7
8
W-R-Y-G
BR-Y
GND.
19

WIRING LEGEND	
CODE	COLOR
B	BLUE
BK	BLACK
BR	BROWN
G	GREEN
O	ORANGE
R	RED
W	WHITE
Y	YELLOW

Figure 54 — Modulator Panel PN-10-A, Wiring Diagram

WIRING LEGEND	
CODE	COLOR
B	BLUE
BK	BLACK
BR	BROWN
G	GREEN
O	ORANGE
R	RED
W	WHITE
Y	YELLOW

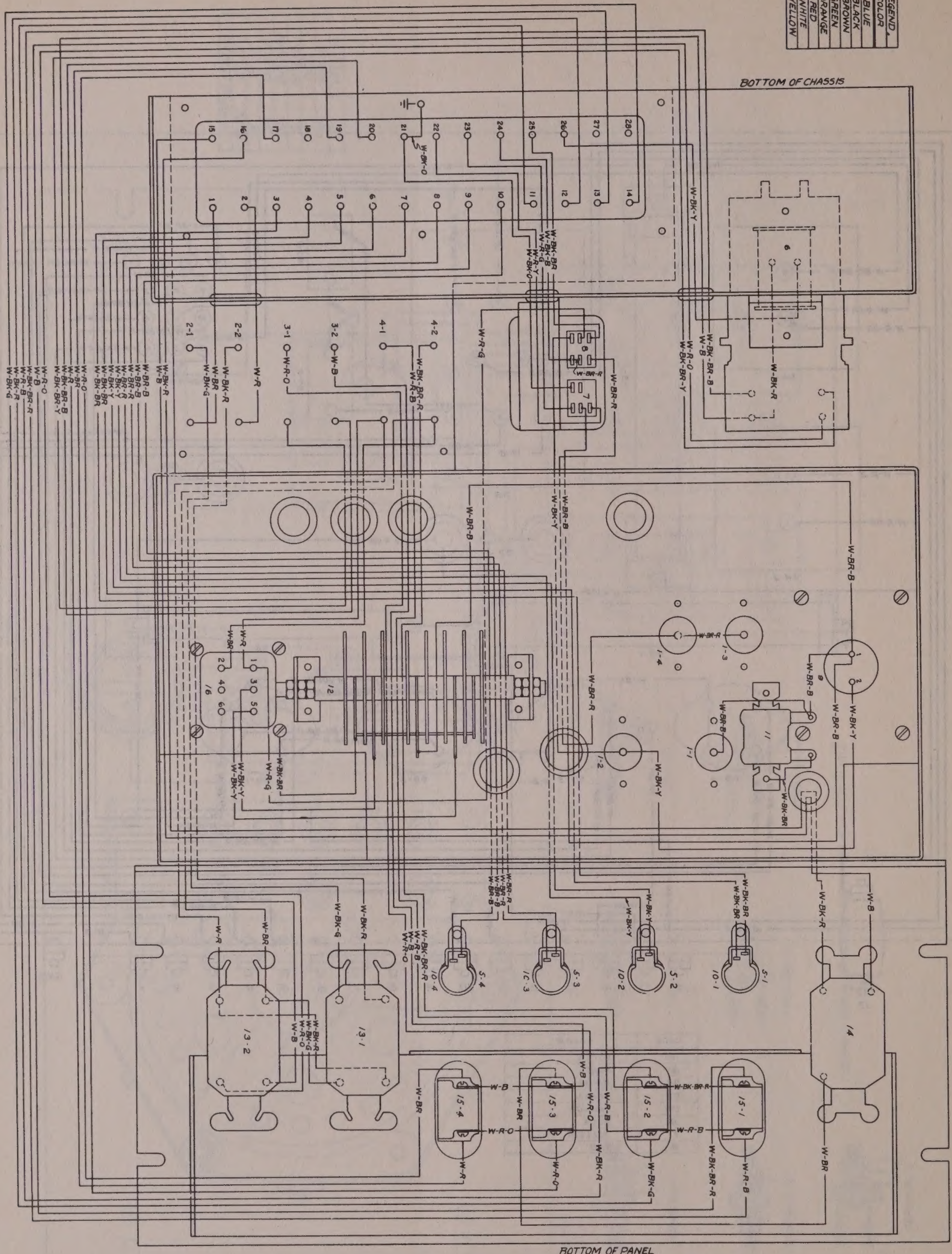
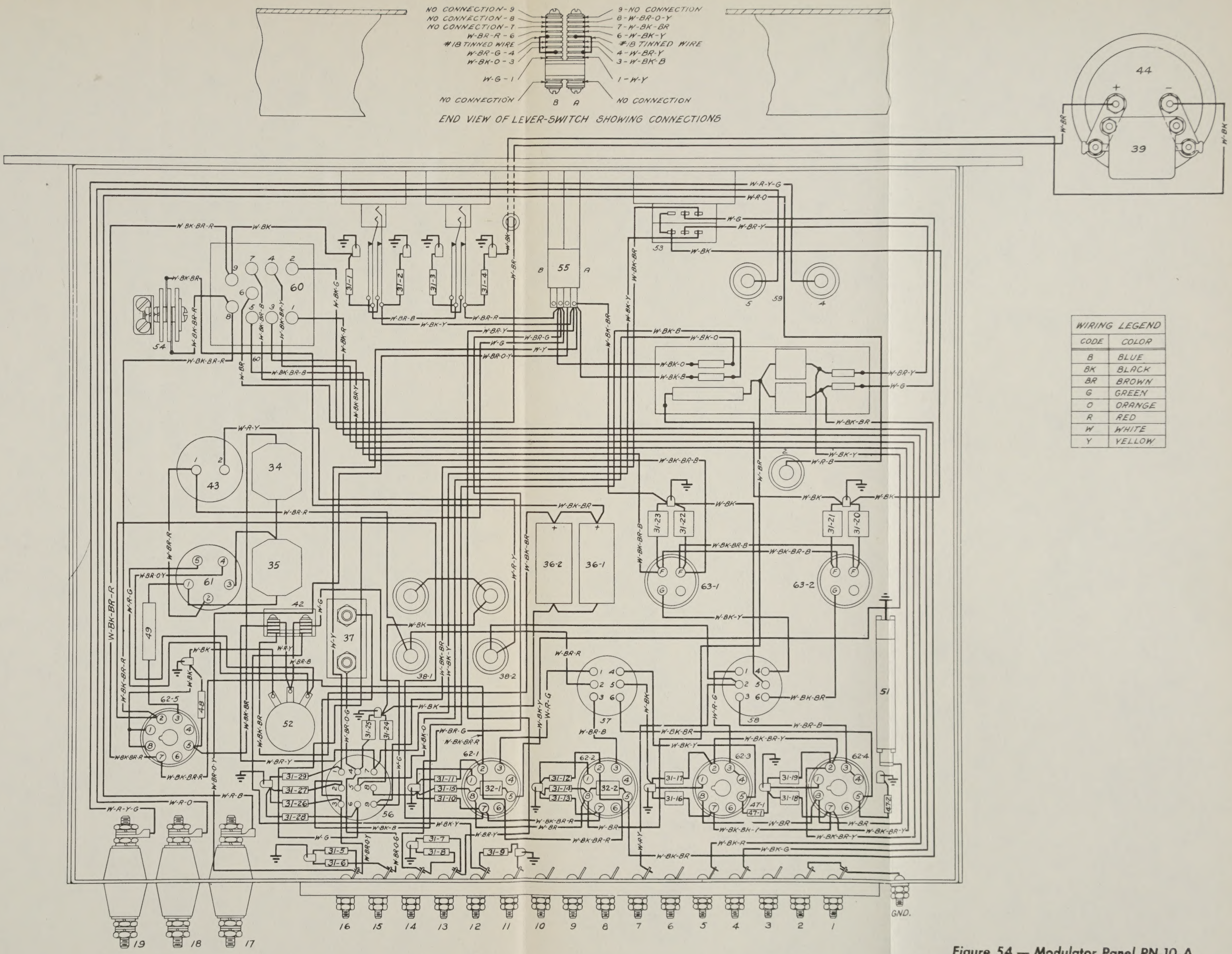
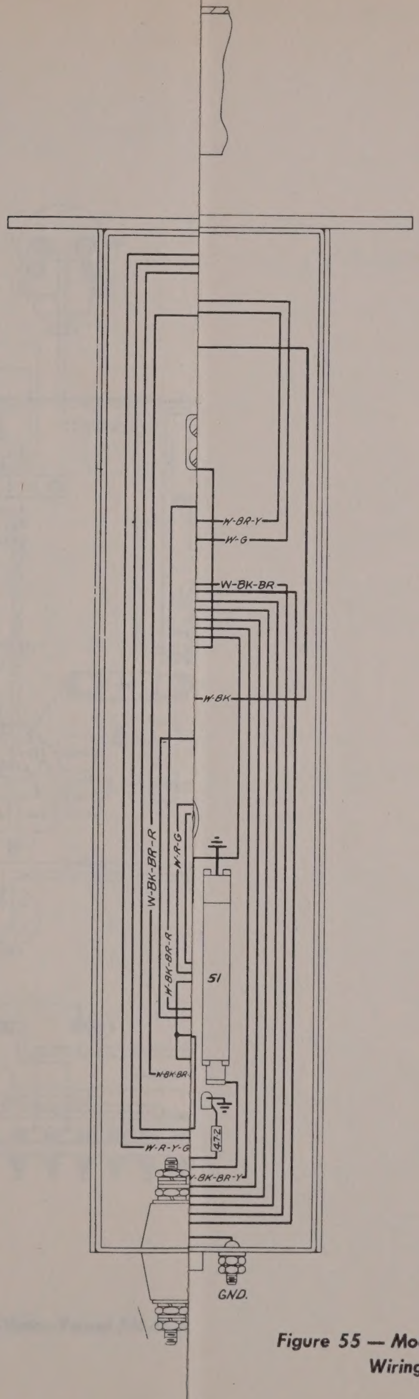

BOTTOM OF CHASSIS
BOTTOM OF PANEL
15
16
17
18
19
20
21
22
23
24
25
26
27
28
1
2
3
4
5
6
7
8
9
10
11
12
13
14
2-1
2-2
3-1
3-2
4-1
4-2
W-BK-O
W-BK-Y
W-BK-R
W-BK-BR-B
W-BK-BR-Y
W-BK-BR-R
W-R-G
W-R-O
W-R-B
W-BR-R
W-BR-B
W-BR
W-BK-G
W-BK-BR
W-B
W-R
W-BK-R
1-1
1-2
1-3
1-4
5-1
5-2
5-3
5-4
10-1
10-2
10-3
10-4
11
12
13-1
13-2
14
15-1
15-2
15-3
15-4
16

Figure 53 — Control Panel PN-11-A, Wiring Diagram


NO CONNECTION - 9
NO CONNECTION - 8
NO CONNECTION - 7
W-BR-R - 6
#18 TINNED WIRE
W-BR-G - 4
W-BK-O - 3
W-G - 1
NO CONNECTION
B
A
9 - NO CONNECTION
8 - W-BR-O-Y
7 - W-BK-BR
6 - W-BK-Y
#18 TINNED WIRE
4 - W-BR-Y
3 - W-BK-B
1 - W-Y
NO CONNECTION
END VIEW OF LEVER-SWITCH SHOWING CONNECTIONS
44
39
W-BR
W-BK
W-R-Y-G
W-R-O
W-G
W-BR-Y
W-BK
53
55
59
5
4
60
54
31-1
31-2
31-3
31-4
W-BK-BR-R
W-BK-BR
W-BK-G
W-BR-B
W-BK-Y
W-BR-R
W-BR-G
W-BR-O-Y
W-Y
W-BK-B
W-BK-O
W-BK-BR-B
W-R-Y
43
34
35
W-BR-R
61
42
49
37
36-2
36-1
38-1
38-2
31-23
31-22
31-21
31-20
63-1
63-2
51
52
56
57
58
48
62-5
62-1
62-2
62-3
62-4
32-1
32-2
31-24
31-25
31-26
31-27
31-28
31-29
31-5
31-6
31-7
31-8
31-9
31-10
31-11
31-12
31-13
31-14
31-15
31-16
31-17
31-18
31-19
47-1
47-2
W-R-O
W-R-B
W-R-Y-G
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
GND.
19
18
17

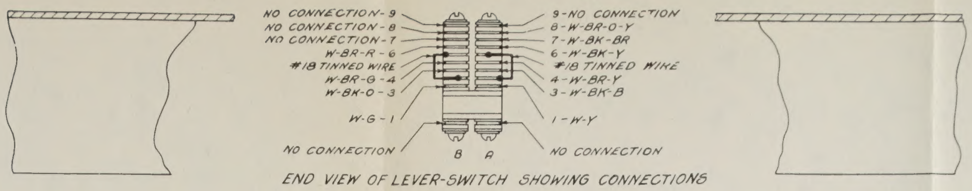
WIRING LEGEND	
CODE	COLOR
B	BLUE
BK	BLACK
BR	BROWN
G	GREEN
O	ORANGE
R	RED
W	WHITE
Y	YELLOW

Figure 54 — Modulator Panel PN-10-A, Wiring Diagram

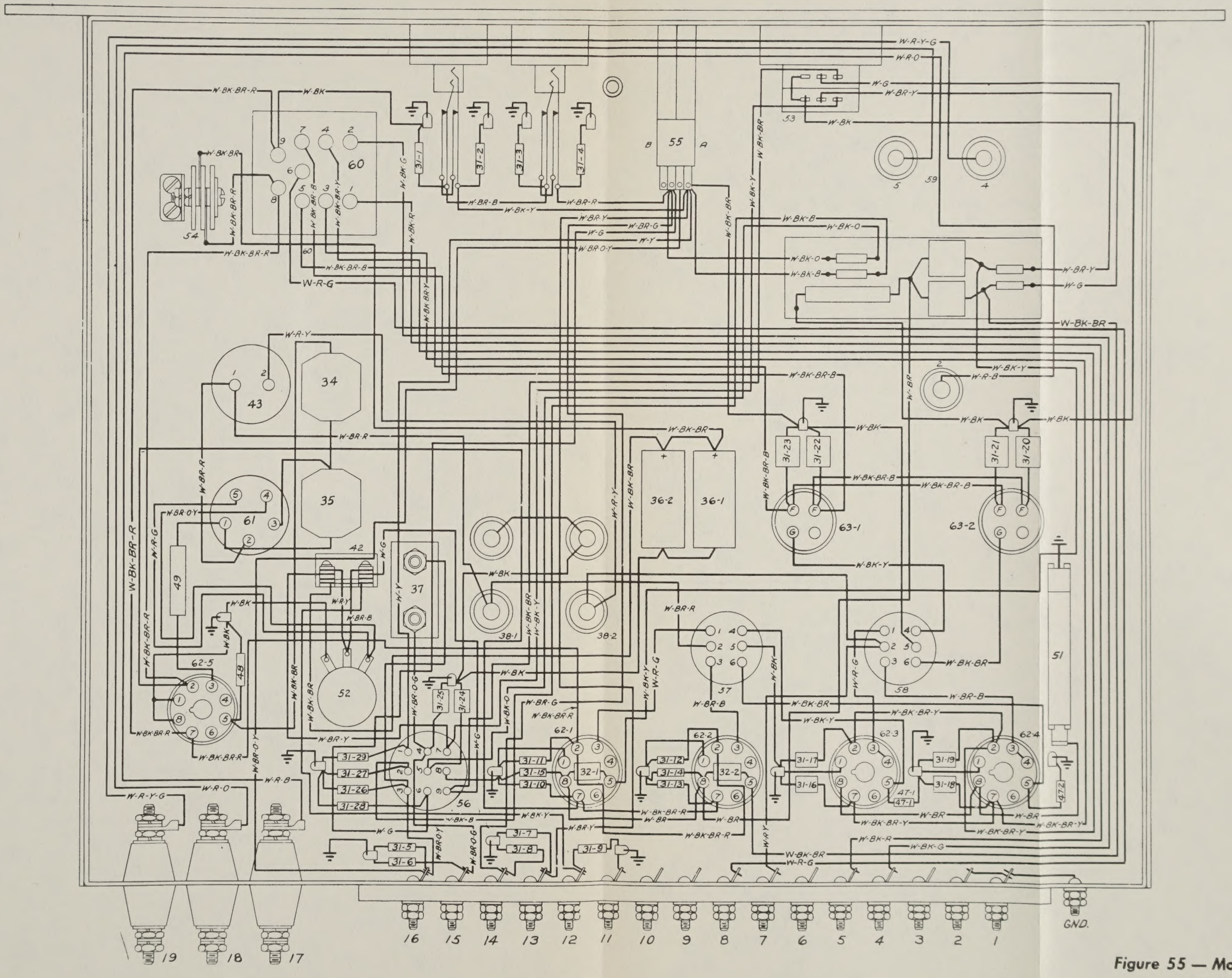

W-BR-Y
W-G
W-BK-BR
W-BK
W-BK-BR-R
W-R-G
W-BK-BR-R
51
W-BK-BR
W-R-Y-G
47-2
Y-BK-BR-Y
GND.

WIRING LEGEND	
CODE	COLOR
B	BLUE
BK	BLACK
BR	BROWN
G	GREEN
O	ORANGE
R	RED
W	WHITE
Y	YELLOW

Figure 55 — Modulator Panel PN-10-B, Wiring Diagram

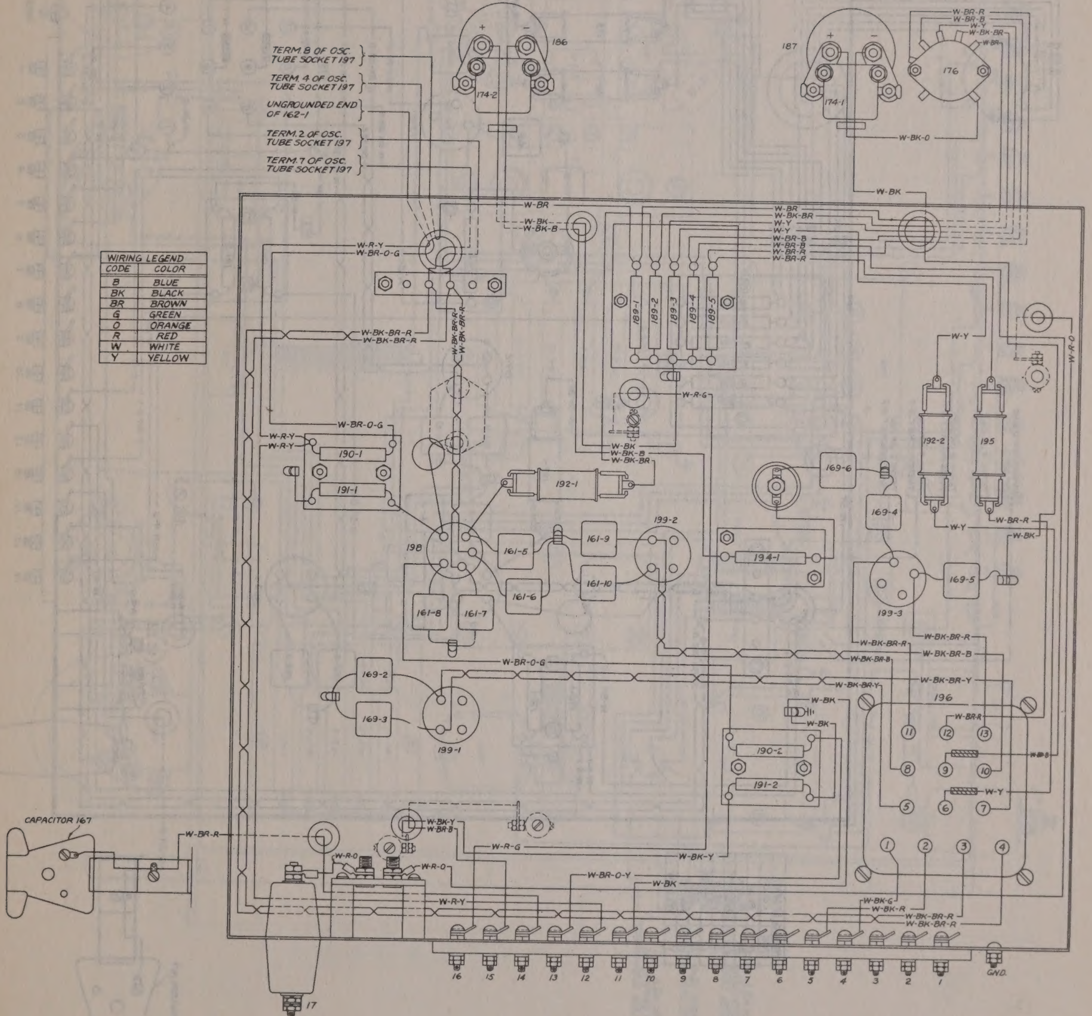

NO CONNECTION-9
NO CONNECTION-8
NO CONNECTION-7
W-BR-R-6
#18 TINNED WIRE
W-BR-G-4
W-BK-O-3
W-G-1
NO CONNECTION
B
A
9-NO CONNECTION
8-W-BR-O-Y
7-W-BK-BR
6-W-BK-Y
#18 TINNED WIRE
4-W-BR-Y
3-W-BK-B
1-W-Y
NO CONNECTION

END VIEW OF LEVER-SWITCH SHOWING CONNECTIONS


W-R-Y-G
W-R-O
W-G
W-BR-Y
W-BK
W-BK-BR-R
55
53
59
5
4
60
54
31-1
31-2
31-3
31-4
W-BR-B
W-BK-Y
W-BR-R
W-BK-B
W-BK-O
W-BR-G
W-Y
W-BR-O-Y
W-R-G
W-BK-BR-B
W-BK-BR
W-R-Y
43
34
35
61
42
37
49
48
52
62-5
56
62-1
62-2
62-3
62-4
32-1
32-2
36-2
36-1
38-1
38-2
63-1
63-2
31-20
31-21
31-22
31-23
51
58
57
47-1
47-2
W-R-B
W-R-O
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
GND.
19
18
17

WIRING LEGEND	
CODE	COLOR
B	BLUE
BK	BLACK
BR	BROWN
G	GREEN
O	ORANGE
R	RED
W	WHITE
Y	YELLOW

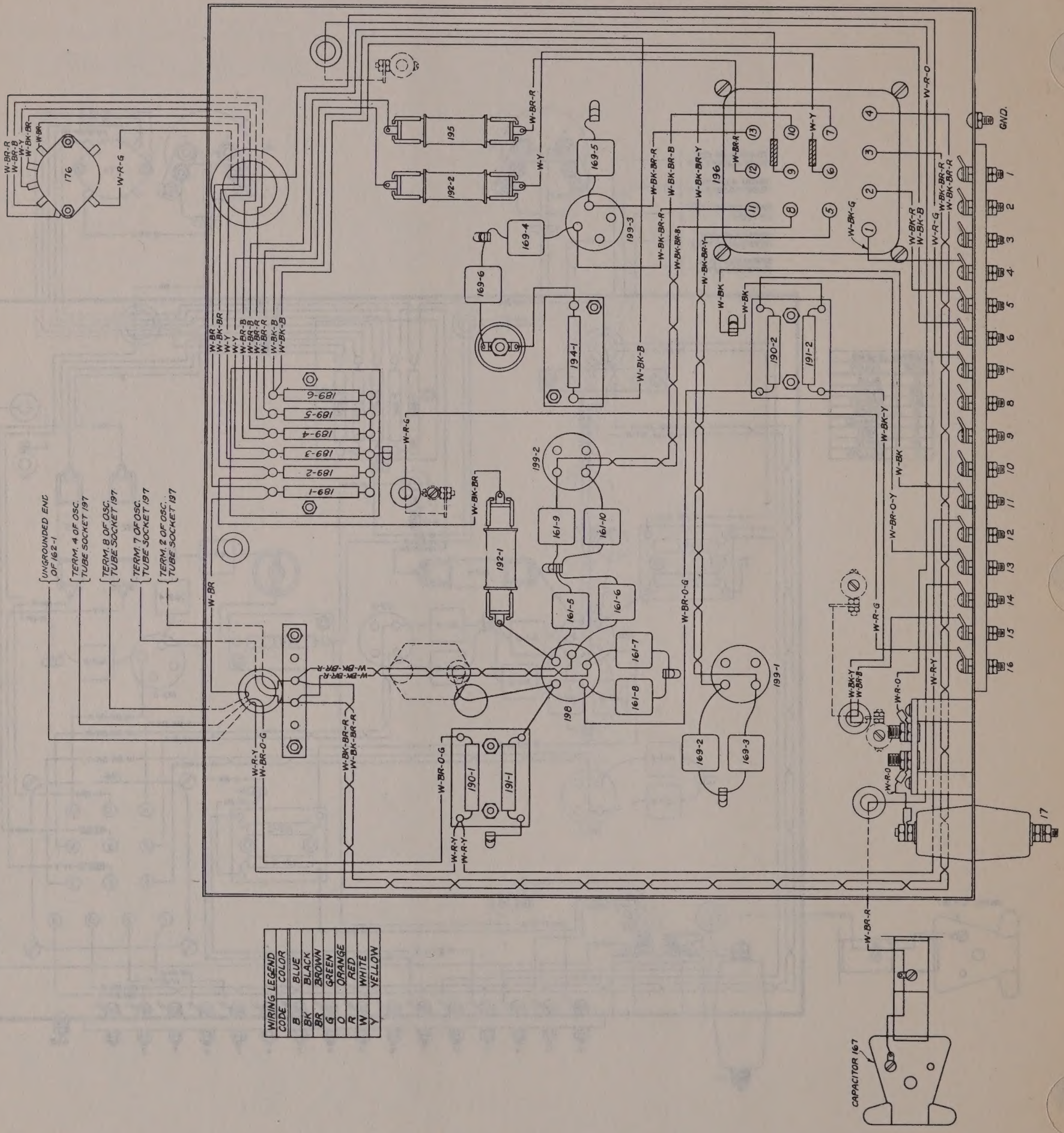
Figure 55 — Modulator Panel PN-10-B, Wiring Diagram


TERM. 8 OF OSC. TUBE SOCKET 197
TERM. 4 OF OSC. TUBE SOCKET 197
UNGROUNDED END OF 162-1
TERM. 2 OF OSC. TUBE SOCKET 197
TERM. 7 OF OSC. TUBE SOCKET 197
186
174-2
187
174-1
176
W-BR-R
W-BR-B
W-Y
W-BK-BR
W-BR
W-BK-O
W-BK
W-BK-B
W-R-Y
W-BR-O-G
W-BK-BR-R
W-BK-BR-B
W-BK-BR-Y
W-BR-R
W-Y
W-R-G
W-R-O
W-BK-Y
W-BK-G
189-1
189-2
189-3
189-4
189-5
190-1
191-1
192-1
192-2
195
169-6
169-4
169-5
169-2
169-3
198
161-5
161-9
161-10
161-6
161-8
161-7
199-2
199-1
199-3
194-1
190-2
191-2
196
CAPACITOR 167
W-R-O
W-BR-O-Y
W-R-Y
17
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
GND.

WIRING LEGEND

CODE	COLOR
B	BLUE
BK	BLACK
BR	BROWN
G	GREEN
O	ORANGE
R	RED
W	WHITE
Y	YELLOW

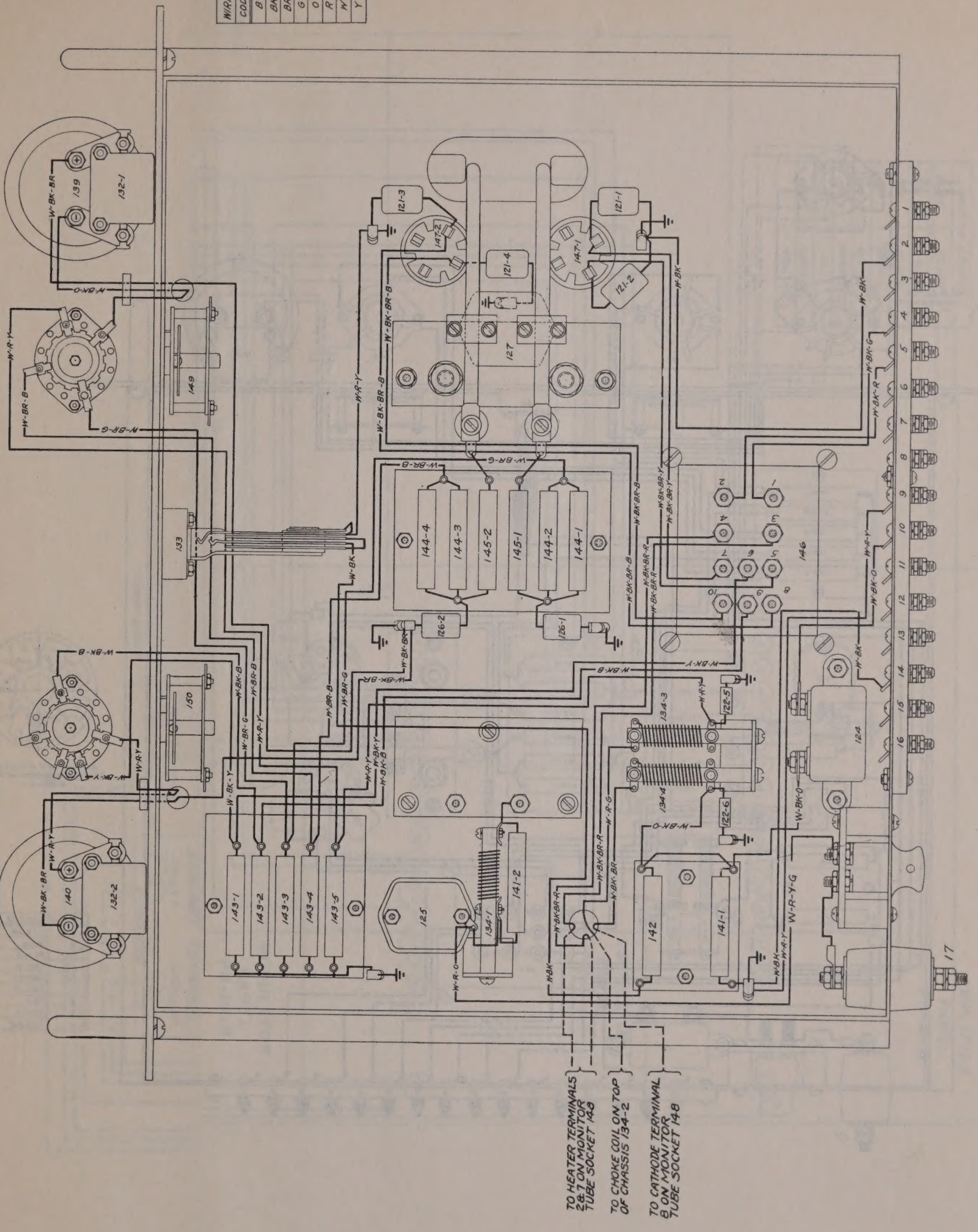
Figure 56 — Oscillator Panel PN-9-A, Wiring Diagram


176
W-BR-R
W-BR-B
W-Y
W-BK-BR
W-BR
W-R-G
195
192-2
W-BR-R
W-Y
169-5
169-4
169-6
199-3
196
W-BK-BR-R
W-BK-BR-B
W-BK-BR-Y
W-BK-G
W-R-O
W-BK-BR-R
W-BK-B
W-BK
194-1
190-2
191-2
W-BR
W-BK-BR
W-BR-B
W-BR-R
W-BK-B
189-1
189-2
189-3
189-4
189-5
189-6
W-R-G
W-BK-BR
199-2
161-9
161-10
192-1
161-5
161-6
161-7
161-8
198
199-1
169-2
169-3
W-BK-BR-R
W-BR-O-G
W-BK-Y
W-BR-O-Y
W-R-Y
190-1
191-1
W-BR-O-G
W-R-Y
W-R-O
17
GND.
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
UNGROUNDED END OF 162-1
TERM. 4 OF OSC. TUBE SOCKET 197
TERM. 8 OF OSC. TUBE SOCKET 197
TERM. 7 OF OSC. TUBE SOCKET 197
TERM. 2 OF OSC. TUBE SOCKET 197
W-BR-R
CAPACITOR 167

WIRING LEGEND	
CODE	COLOR
B	BLUE
BK	BLACK
BR	BROWN
G	GREEN
O	ORANGE
R	RED
W	WHITE
Y	YELLOW

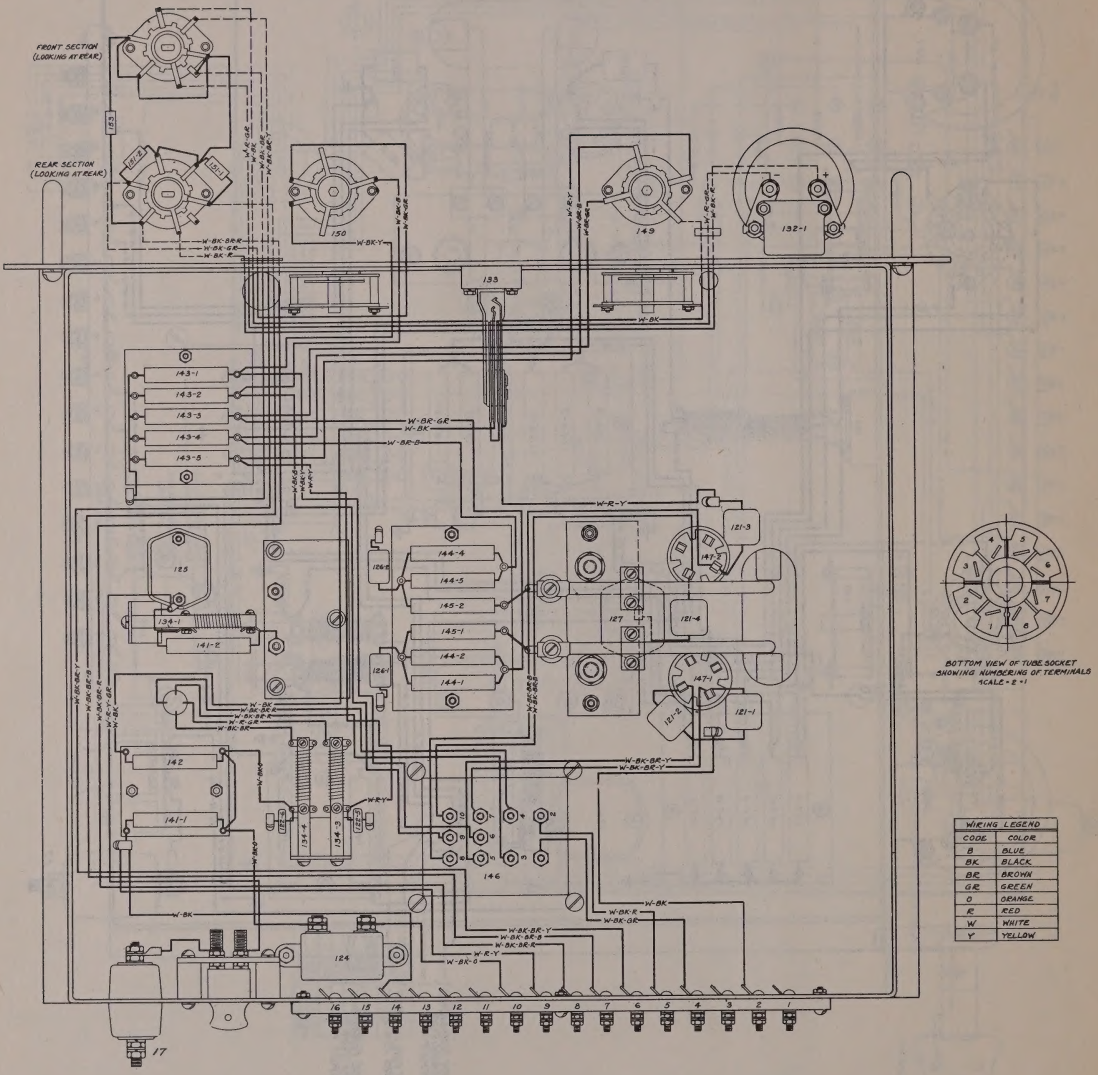
Figure 57 — Oscillator Panel PN-9-B, Wiring Diagram

WIRING LEGEND	
CODE	COLOR
B	BLUE
BK	BLACK
BR	BROWN
G	GREEN
O	ORANGE
R	RED
W	WHITE
Y	YELLOW



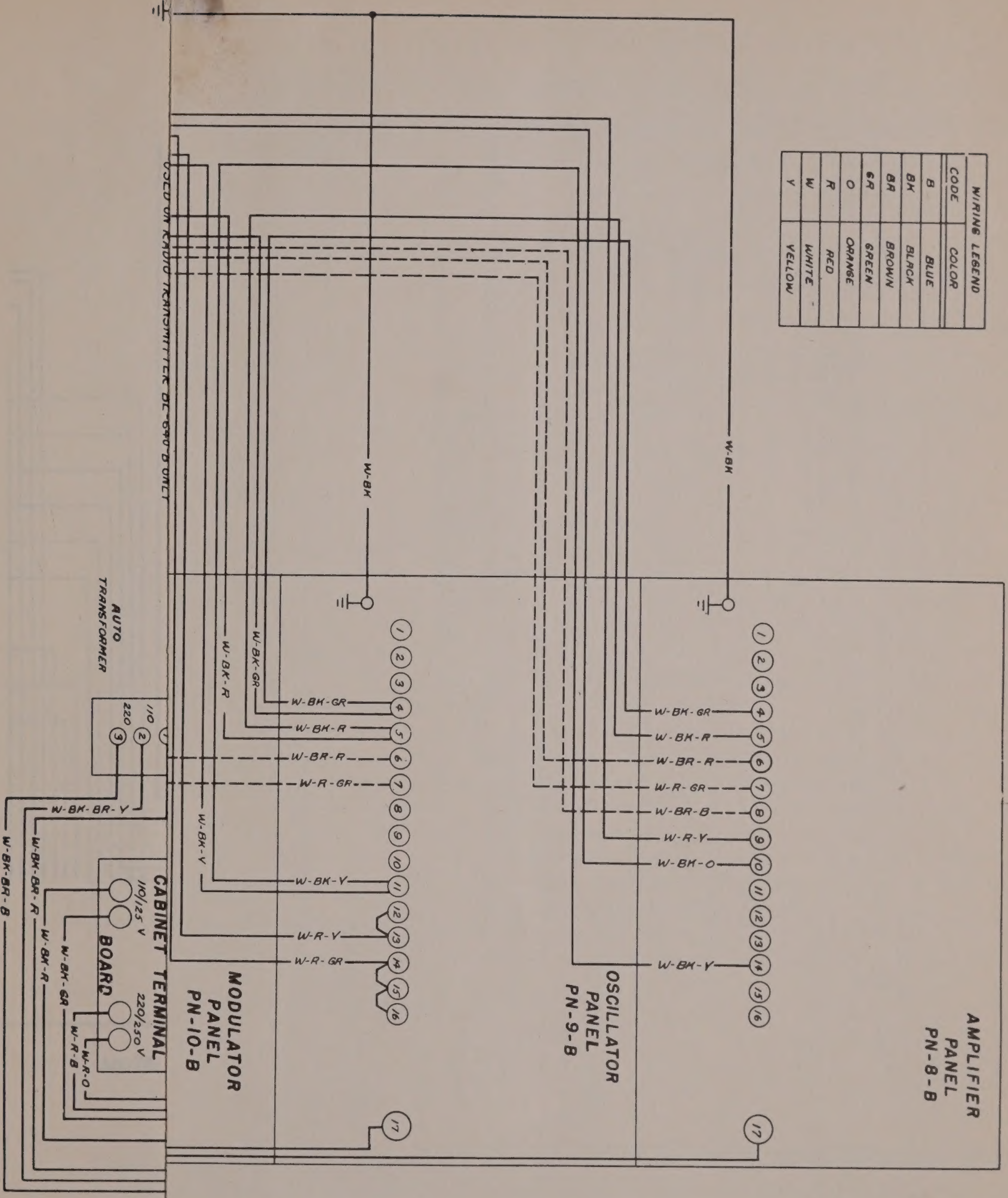
139
132-1
W-BK-BR
W-BK-O
W-R-Y
149
W-BR-B
W-BR-G
133
W-BK-B
150
W-BK-Y
W-R-Y
140
132-2
W-BK-BR
143-1
143-2
143-3
143-4
143-5
125
134-1
141-2
121-3
147-2
121-4
147-1
121-1
121-2
127
W-BK-BR-B
W-R-Y
W-BR-G
W-BR-B
144-4
144-3
145-2
145-1
144-2
144-1
126-2
126-1
W-BK
W-BK-BR
W-BR-G
W-BK-BR-B
W-BK-BR-R
W-BK-BR-Y
146
W-BK-Y
W-BK-B
W-R-Y
122-5
134-3
134-4
122-6
W-BK-O
W-R-G
W-BK-BR-R
W-BK-BR
142
141-1
W-R-O
W-BK
W-BK-G
W-BK-R
W-BK-O
W-R-Y-G
124
17
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
TO HEATER TERMINALS 2&7 ON MONITOR TUBE SOCKET 148
TO CHOKE COIL ON TOP OF CHASSIS 134-2
TO CATHODE TERMINAL 8 ON MONITOR TUBE SOCKET 148

Figure 58 — Amplifier Panel PN-8-A, Wiring Diagram


FRONT SECTION (LOOKING AT REAR)
REAR SECTION (LOOKING AT REAR)
153
151-2
151-1
150
149
132-1
133
143-1
143-2
143-3
143-4
143-5
125
134-1
141-2
142
141-1
134-4
134-3
144-4
144-5
145-2
145-1
144-2
144-1
126-1
127
121-1
121-2
121-3
121-4
147-1
147-2
146
124
17
W-BK-BR-R
W-BK-GR
W-BK-R
W-BK-Y
W-R-Y
W-BR-GR
W-BK
W-BR-B
W-BK-BR-Y
W-BK-BR-B
W-BK-BR-R
W-R-Y-GR
W-BK-O
W-BK-GR
W-R-GR
W-BK-BR
16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1
BOTTOM VIEW OF TUBE SOCKET SHOWING NUMBERING OF TERMINALS SCALE = 2 = 1
1 2 3 4 5 6 7 8
WIRING LEGEND

CODE	COLOR
B	BLUE
BK	BLACK
BR	BROWN
GR	GREEN
O	ORANGE
R	RED
W	WHITE
Y	YELLOW

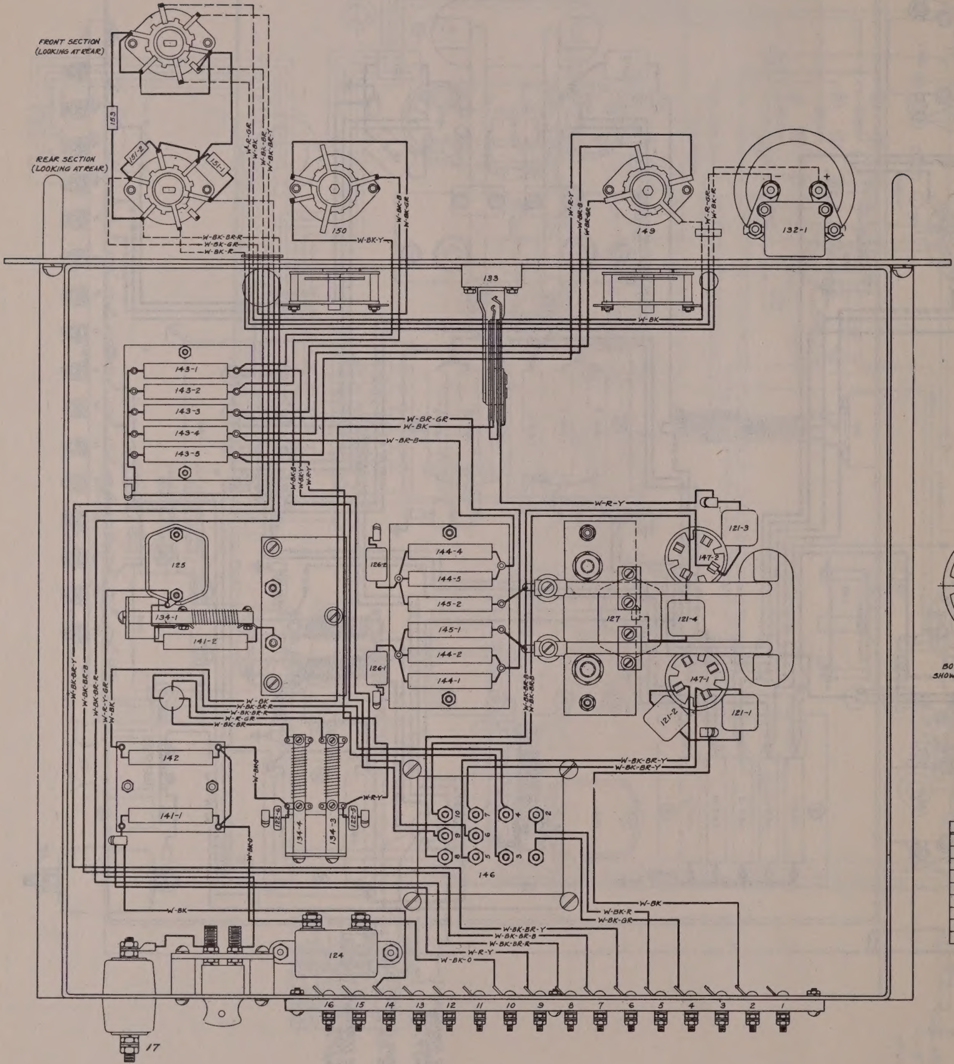
Figure 59 — Amplifier Panel PN-8-B, Wiring Diagram

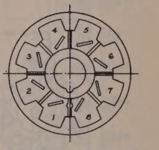

USED ON RADIO TRANSMITTER BC-640-B ONLY
W-BK
W-BK
AMPLIFIER PANEL PN-8-B
OSCILLATOR PANEL PN-9-B
MODULATOR PANEL PN-10-B
CABINET TERMINAL BOARD
110/125 V
220/250 V
AUTO TRANSFORMER
110
220
W-BK-GR
W-BK-R
W-BR-R
W-R-GR
W-BR-B
W-R-Y
W-BK-O
W-BK-Y
W-R-Y
W-R-GR
W-BK-V
W-BK-BR-Y
W-BK-BR-B
W-BK-BR-R
W-BK-GR
W-R-B
W-R-O

WIRING LEGEND

CODE	COLOR
B	BLUE
BK	BLACK
BR	BROWN
GR	GREEN
O	ORANGE
R	RED
W	WHITE
Y	YELLOW

Figure 60 — Radio Transmitter BC-640-A, and BC-640-B, Interpanel Wiring Diagram

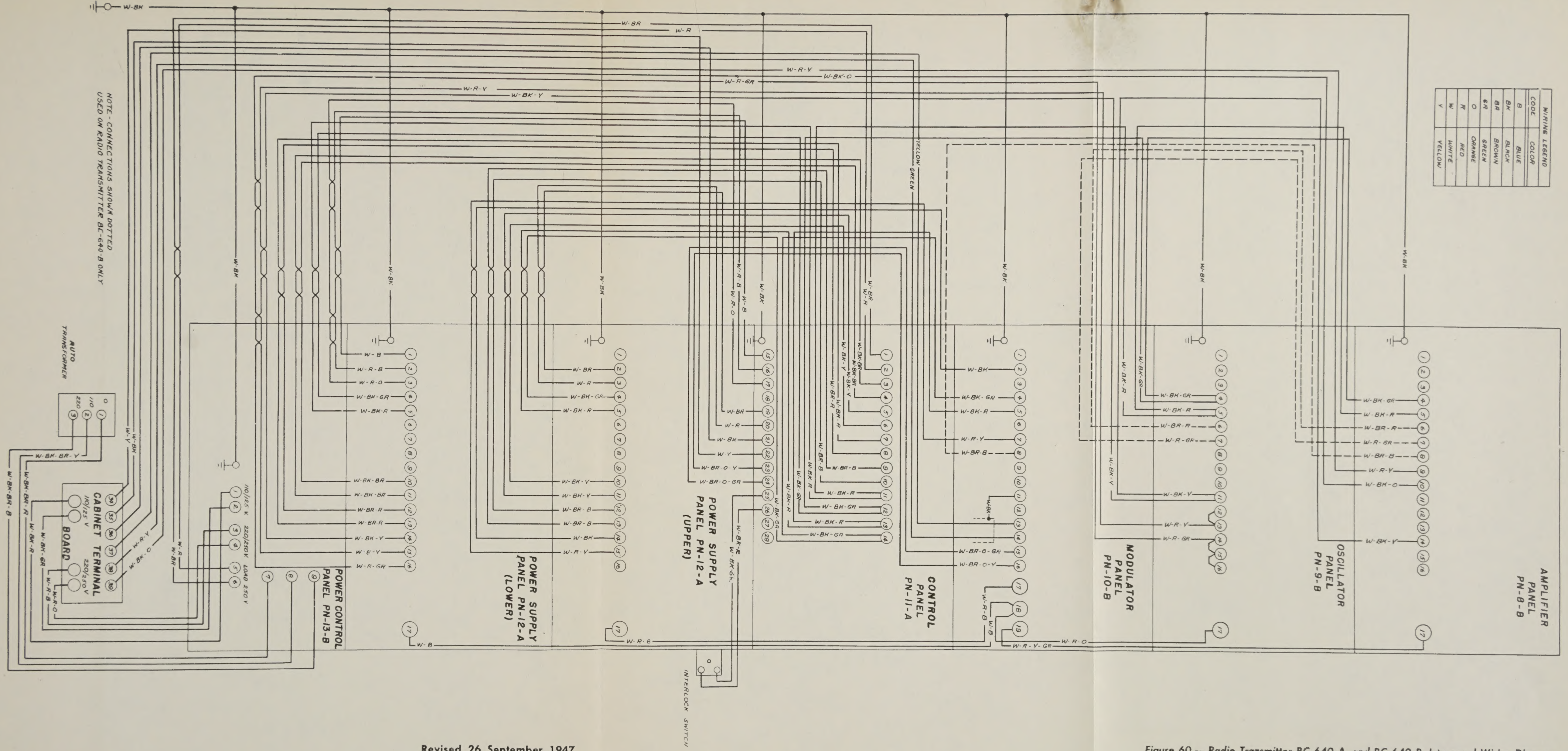

FRONT SECTION (LOOKING AT REAR)
REAR SECTION (LOOKING AT REAR)
153
151-2
151-1
W-R-GR
W-BK
W-BK-BR-Y
150
W-BK-Y
W-BK-B
W-BK-GR
149
W-R-Y
W-R-GR
W-BK-R
+
132-1
133
W-BK-BR-R
W-BK-GR
W-BK-R
W-BK
143-1
143-2
143-3
143-4
143-5
W-BR-GR
W-BK
W-BR-B
W-R-Y
121-3
147-2
121-4
127
147-1
121-2
121-1
125
134-1
141-2
126-2
144-4
144-5
145-2
145-1
144-2
144-1
126-1
W-BK-BR-Y
W-BK-BR-B
W-BK-BR-R
W-R-Y-GR
W-BK-BR-R
W-R-GR
W-BK-BK
142
141-1
122-4
134-4
134-3
122-3
W-BK-O
10
7
4
2
9
6
5
8
3
146
W-BK-R
W-BK-GR
W-BK-BR-B
W-BK-O
124
17
16
15
14
13
12
11
1



BOTTOM VIEW OF TUBE SOCKET SHOWING NUMBERING OF TERMINALS SCALE = 2 = 1

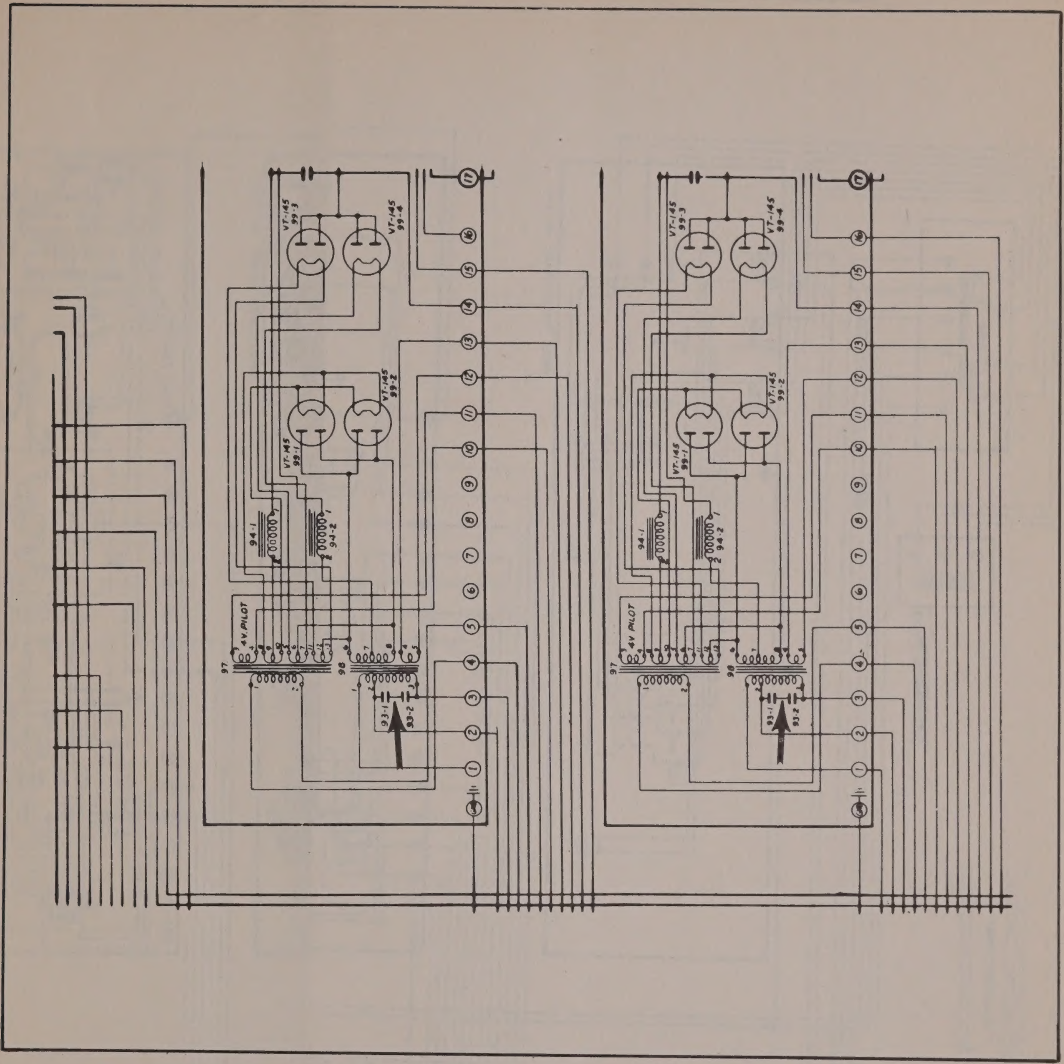
WIRING LEGEND	
CODE	COLOR
B	BLUE
BK	BLACK
BR	BROWN
GR	GREEN
O	ORANGE
R	RED
W	WHITE
Y	YELLOW

Figure 59 — Amplifier Panel PN-8-B, Wiring Diagram


NOTE - CONNECTIONS SHOWN DOTTED USED ON RADIO TRANSMITTER BC-640-B ONLY
AUTO TRANSFORMER
0
110
220
CABINET TERMINAL BOARD
110/125 V
220/250 V
110/125 V
220/250 V
LOAD 230 V
POWER CONTROL PANEL PN-13-B
POWER SUPPLY PANEL PN-12-A (LOWER)
POWER SUPPLY PANEL PN-12-A (UPPER)
INTERLOCK SWITCH
CONTROL PANEL PN-11-A
MODULATOR PANEL PN-10-B
OSCILLATOR PANEL PN-9-B
AMPLIFIER PANEL PN-8-B
YELLOW
GREEN
W-BK
W-BR
W-R
W-R-Y
W-BK-O
W-R-GR
W-BK-Y

WIRING LEGEND	
CODE	COLOR
B	BLUE
BK	BLACK
BR	BROWN
GR	GREEN
O	ORANGE
R	RED
W	WHITE
Y	YELLOW

Figure 60 — Radio Transmitter BC-640-A, and BC-640-B, Interpanel Wiring Diagram


VT-145
99-3
VT-145
99-4
VT-145
99-2
VT-145
99-1
94-1
94-2
4V. PILOT
97
98
93-1
93-2
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17

NOTE: On Figure 61, remove ground connections between 93-1 and 93-2

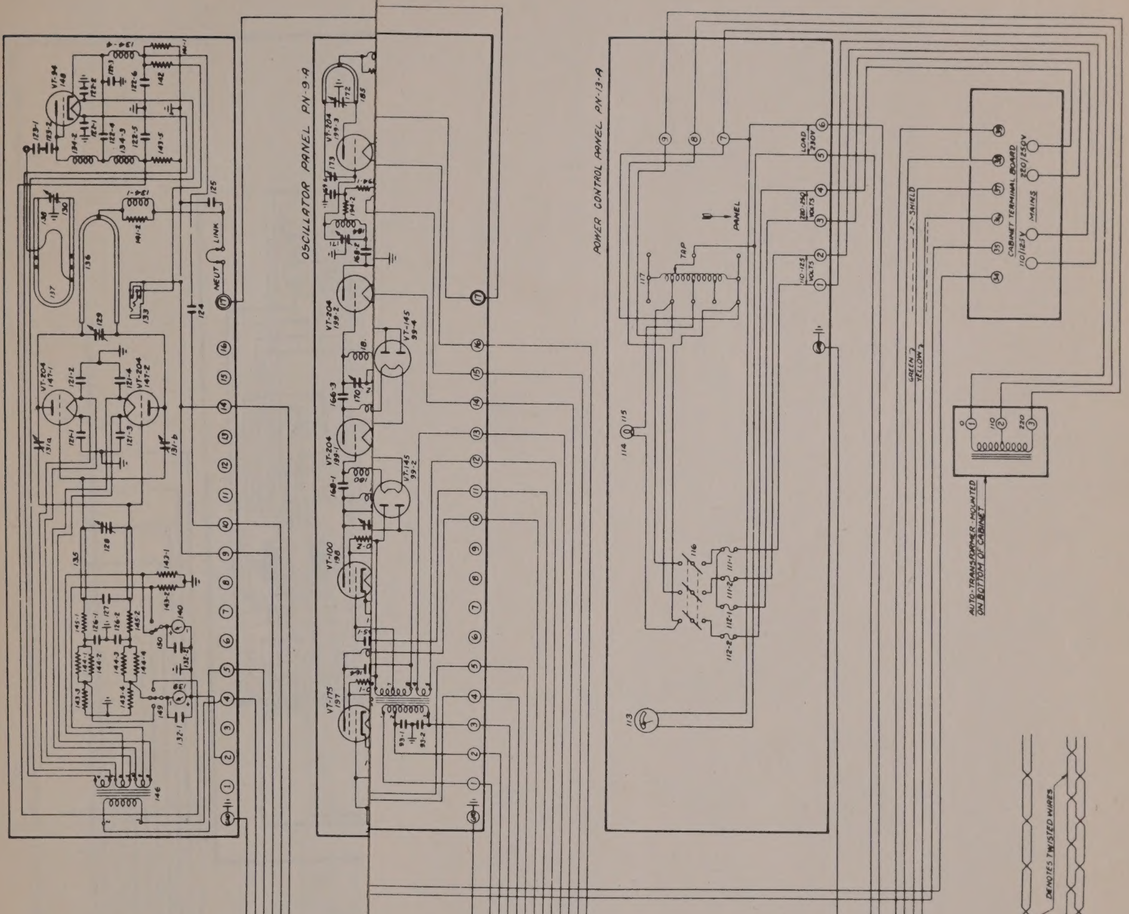

AMPLIFIER PANEL PN-8-A
OSCILLATOR PANEL PN-9-A
POWER CONTROL PANEL PN-13-A
NEUT
LINK
TRIP
PANEL
LOAD 230V
110-125 VOLTS
SHIELD
GREEN
YELLOW
CABINET TERMINAL BOARD
MAINS
110/125V
220/250V
AUTO-TRANSFORMER-MOUNTED ON BOTTOM OF CABINET
DENOTES TWISTED WIRES
GROUND WIRES FROM EACH PANEL CABLED AND CONNECTED TO BINDING POST ON CABINET

Figure 61 — Radio Transmitter BC-640-A, Schematic Diagram

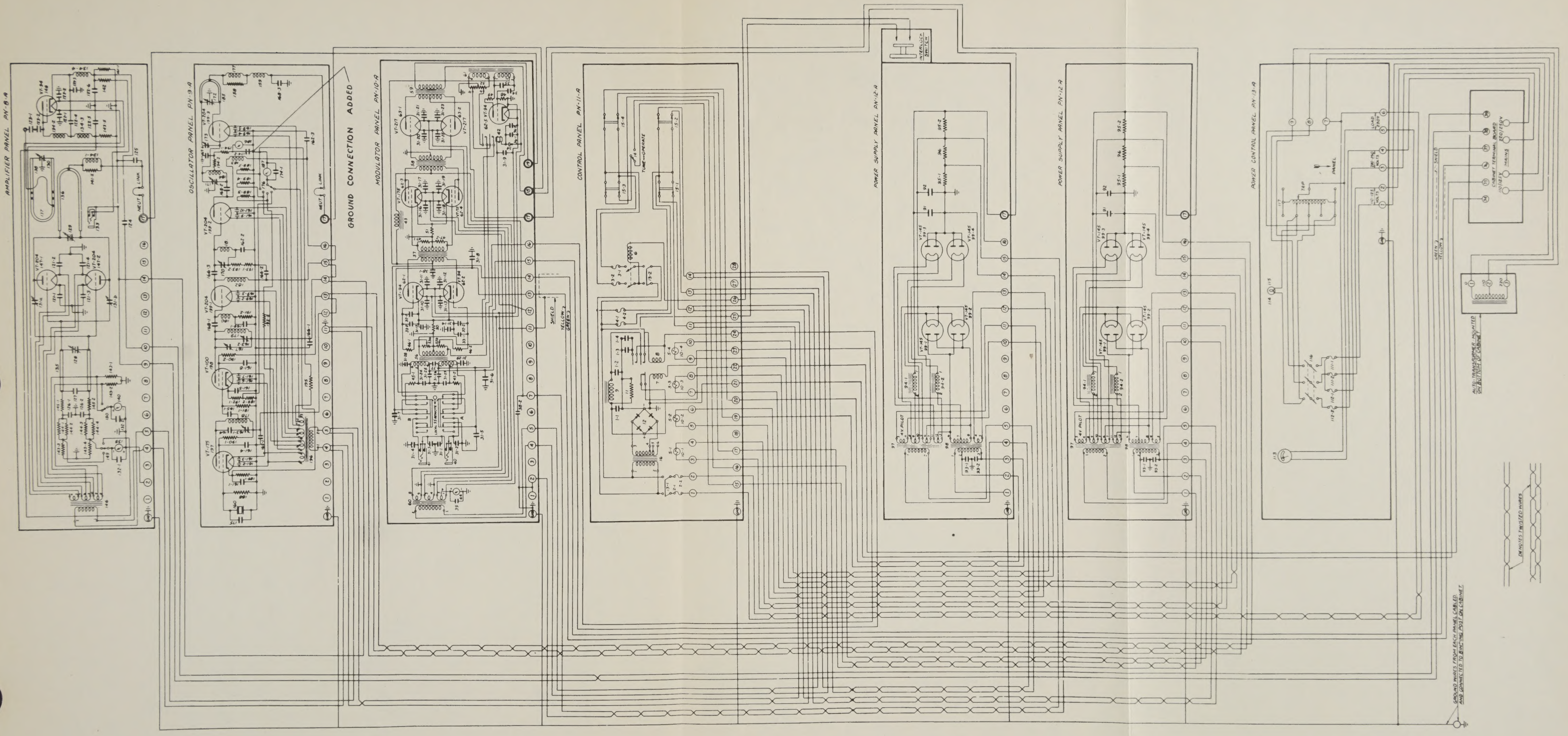
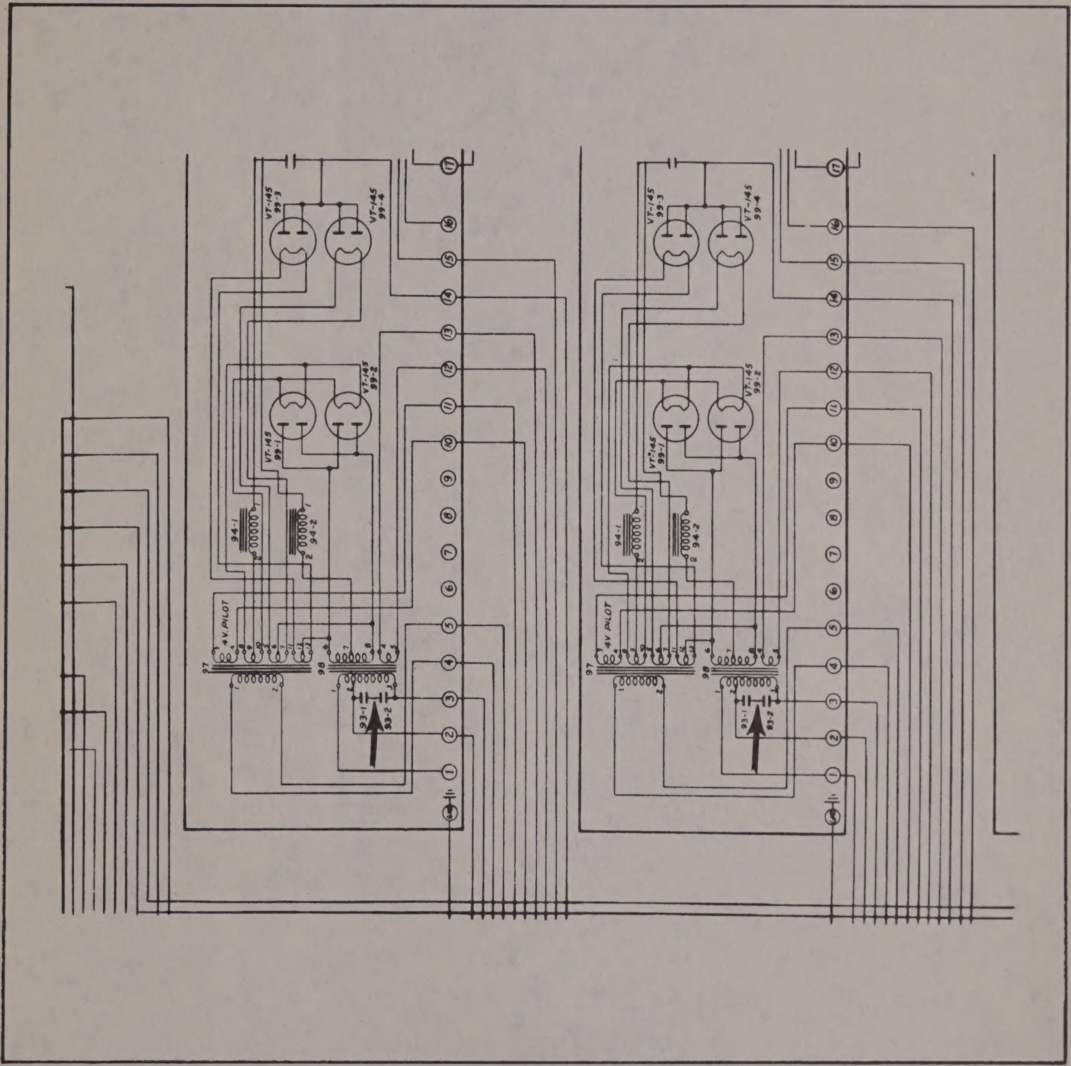

AMPLIFIER PANEL PN-8-A
OSCILLATOR PANEL PN-9-A
GROUND CONNECTION ADDED
MODULATOR PANEL PN-10-A
SHIELD
YELLOW-2
GREEN-2
CONTROL PANEL PN-11-A
TUNE—OPERATE
INTERLOCK SWITCH
POWER SUPPLY PANEL PN-12-A
POWER SUPPLY PANEL PN-12-A
POWER CONTROL PANEL PN-13-A
CABINET TERMINAL BOARD
MAINS
220/250V
110/125V
SHIELD
GREEN
YELLOW
0
110
220
AUTO-TRANSFORMER MOUNTED ON BOTTOM OF CABINET
DENOTES TWISTED WIRES
GROUND WIRES FROM EACH PANEL CABLED AND CONNECTED TO BINDING POST ON CABINET.

Figure 61 — Radio Transmitter BC-640-A, Schematic Diagram


VT-145
99-3
VT-145
99-4
VT-145
99-1
VT-145
99-2
94-1
94-2
4V PILOT
97
98
93-1
93-2
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17

NOTE: On Figure 62, remove ground connections between 93-1 and 93-2